JPRS-UTR-84-023

7 August 1984

USSR Report

TRANSPORTATION

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CIVIL AVIATION

PORTABLE ELECTRIC ENGINE PREHEATER FOR ANTONOV AIRCRAFT

Moscow VOZDUSHNYY TRANSPORT in Russian 19 May 84 p 3

[Article by S. Gorodnitskiy, chief engineer, Yakutsk UGA [Civil Aviation Administration]; G. Ustyuzhanin, chief engineer of the ATB [air maintenance base] of the Yakutsk Aviation Enterprise; and Ye. Serikov, senior scientific associate of the GosNII GA [State Scientific Research Institute of Civil Aviation] and candidate of technical sciences: "Economically and Productively"]

[Text] An An-24 with the side number 46352 was parked on the ramp of Mirnyy Airport along with other aircraft. Aviation Technician B. Mikhaylov is "mysteriously engaged" at the aircraft. L. Tarchenko approaches him.

"The heaters aren't working poorly? he asked.

"They're fine... And how were you able to contrive such an original preheater?!"

Tarchenko is already accustomed to such questions, and to the thanks and complimentary words directed at him. For this reason, he took what was said calmly and then suggested:

"Let's have a look at how the heaters are working..."

In the lower hatch of the engine nacelle cowling, where they used to insert a hose from the airport heater, an electric preheater has been attached. A technician put it on soon after the aircraft had taxied in to the parking area. The aircraft's other engine also has the same type of heater in the cowling. A cord extends from the preheater to an electric power source.

L. Tarchenko listens closely to the operation of the portable preheater. It is not difficult for the aviation technician to imagine how a screen of the recycled flow of heated air is created under the cowling and prevents its cooling. The second preheater also is operating normally.

The aircraft's technician remained, keeping his eye on the invention's operation, and its inventor headed for other aircraft. And there were none of the cumbersome airport preheaters near them which consume a great deal of fuel before starting the An-24, An-26 and An-12 engines; the electric preheater uses less than 2 kilowatts of power.

It has been calculated that only two of the portable preheaters invented by Aviation Technician L. Tarchenko make it possible to save about 15 tons of aviation fuel and about 5 tons of vehicle gasoline annually. And if it is taken into account that the electric preheaters also release the maintenance personnel who attend to the preheating of aircraft engines, the introduction of a unit of two portable preheaters yields an annual economic gain of over 28,000 rubles. It is not difficult to multiply this sum by the number of aircraft with engines which require preheating before startup...

In a word, the benefit of L. Tarchenko's innovation is obvious. The new procedure not only keeps the aircraft in constant readiness for flight, but eliminates the sharp drops in the temperature of engine components, which has a favorable effect on their operating characteristics and reduces contamination of the environment by the exhaust gases of fueled heaters as well.

It has been recommended that the Yakutsk administration's experience in making and operating electric preheaters be disseminated to other subunits of the sector as well.

Until recently, there were a great many difficulties in ensuring regularity of flights and the readiness of aviation equipment in Yakutia, where the cold season is more than 7 months long. Low temperatures have complicated the technical maintenance of airplanes and helicopters. This also became the original reason for searching for new ways to improve the working conditions of airports' maintenance personnel. And it is no coincidence that namely L. Tarchenko, who knows the aviation technician's work well, found an original way to keep aircraft engines in a condition of readiness for flight.

The portable units also are beginning to be used as special on-board equipment for An-2 aircraft on flights in northern latitudes of the continent and ocean, instead of the cumbersome fueled preheaters, for keeping the aircraft in a condition of readiness for flight to operational points.

The electric preheaters made by ATB specialists with the methodical guidance of the GosNII GA now are being widely utilized in the Yakutsk administration. The results of their tests and recommendations for their use have been confirmed by the chief of the GUERAT MGA [Main Administration of Operation and Repair of Aviation Technical Equipment, Ministry of Civil Aviation]. Experimental Plant No 85 is mastering industrial production of the electric appliance.

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COLLEGIUM EXAMINES AIRCRAFT REPAIR PROBLEMS, OTHER ISSUES

Moscow VOZDUSHNYY TRANSPORT in Russian 19 May 84 p 2

[Report on proceedings of the Collegium of the Ministry of Civil Aviation]

[Text] The matter of improvement in flight operations was examined at a scheduled meeting. In the decree approved, it is noted that purposeful organizational and political education work is being conducted in the sector by the command-supervisory and command flight personnel in carrying out preventive measures to improve the quality of flights. The most substantial results in this important work have been achieved in the Azerbaijan, Moscow Transport, Turkmen, Urals, Estonian, Kirghiz and Tajik administrations, the radio technical equipment operations and communications base and the GosNII [State Scientific Research Institute].

The objectives of better-quality technical maintenance and repair of airplanes and helicopters have been set. Instances of damage to aircraft on the ground because of serious shortcomings in the work of the airport service, special motor vehicle transport, and the transportation service still have not been eliminated. This has related to administrations such as the Armenian, Volga Region, Ukrainian, Kazakh, Tyumen, Far East and Arkhangelsk.

Analysis shows that the causes which lead to a reduction in the quality and regularity of flights are the inadequate level of executive discipline by certain managers, as well as political education work which is not always effective in inculcating a sense of high responsibility in every aviation worker for carrying out his official duty.

The collegium has required the chiefs of MGA [Ministry of Civil Aviation] administrations and the territorial administrations, enterprises, organizations and institutions of civil aviation to eliminate the shortcomings noted, and to reinforce organizational and political education work in labor collectives, having devoted particular attention to reinforcement of discipline, improvement in the level of flying skill, and the vocational training of controllers and engineering and technical personnel. The decree outlines specific steps to implement the plans of measures aimed at improving the quality and regularity of flights.

The MGA collegium meeting also discussed the status of political education work at the Riga Engineering Institute and the Riga Flight and Technical School of Civil Aviation in light of the requirements of the June (1983) Plenum of the CPSU Central Committee.

The rectorate of the institute and the command of the school, and teachers and instructors, jointly with party, trade union and Komsomol organizations, are carrying out specific work to further improve the ideological and political, labor and moral training of students. A number of steps have been taken to improve organization of the instructional process and its scientific and methodical implementation, as well as development and modernization of educational and laboratory facilities, which as a result has contributed to an increase in the level of vocational training of the aviation specialists being graduated.

However, there are serious omissions in the activity of these educational institutions. The plans for measures to implement the requirements of directive party documents which relate to the orders and decrees of the MGA collegium have been poorly oriented toward the solution of specific practical long-range tasks to improve the educational and training process. Studies have been inadequately coordinated with the problems of development of the sector and with the way of life of aviation enterprise collectives. The work of the departments of social sciences, the engineering and economics faculty, and a series of socioeconomic disciplines is lagging behind requirements. They have not yet become methodological centers for ideological and political education work. Cultural and educational institutions--libraries, clubs, museums--also are being used for these objectives inefficiently. At present, proper development of military-patriotic, vocational-technical and popular athletic work has not been found among the students. Inadequate attention is being devoted to moral and legal education of the youth.

Similar shortcomings exist in the activity of the command and supervisory personnel of the Kirovograd VLU [Higher Flight School], the Slavyansk, Krasnoyarsk and Minsk aviation technical schools, the Buguruslan and Krasnokutsk flight schools, and the Kirovograd flight navigator school.

The MGA collegium approved the decree aimed at radical improvement in ideological and political education work and at increasing its efficiency and effectiveness in the sector's educational institutions. At the foundation of this important work, the collegium decree stresses, must be placed the decisions of the June (1983) and February and April (1984) Plenums of the CPSU Central Committee and the positions and conclusions set forth in speeches at them by Comrade K. U. Chernenko, "The basic directions of reform of the general education and vocational school," which are of vast importance for the economic, sociopolitical and spiritual progress of Soviet society.

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CSO: 1829/296

CIVIL AVIATION

IMPROVEMENTS AT ANAPA AIRPORT IN KRASNODAR KRAY

Moscow VOZDUSHNYY TRANSPORT in Russian 24 May 84 p 4

[Report by correspondent V. Patenko: "Anapa Invites"]

[Text] At the end of April an MGA [Ministry of Civil Aviation] commission conducted an expert technical check of the status of all ground services at Anapa Airport and their readiness for intensive flight activity. According to its competent conclusion, Anapa Airport fully meets the requirements and international standards for ICAO [International Civil Aviation Organization] Category I airports.

"In other words, the airport of the All-Union Children's Maritime Health Resort is practically able to accommodate landings and takeoffs by modern types of aircraft," explains G. Unichenko, chief of the Anapa Airport. "At a given time we are fully prepared for the children's mass arrival and departure."

...I enter the line equipment room of the control tower. V. Sarkisov, senior radio navigation technician and shock worker of communist labor, is working at the "Stroka-B" ["Line B"] panel. Yu. Chekulayev, chief of the International Air Services Central Administration, who is nearby, is directing attention to precise adjustment of the multipurpose equipment which controls the range accuracy of the landing radar, the command stations for the radiobeacon system, and other landing aids.

"All the equipment has also passed a flight check for quality in accordance with the plan for regulated operations," explained Yu. Chekulayev. "Control, maintenance and adjustment have been performed by our best specialists, technicians A. Taranenko and A. Mironov, and the landing system's chief engineer, S. Dolgov."

The airport's traffic service is located in an adjacent room. Shift Chief V. Yeromasov and Controller A. Khmyrev were on duty here at a panel of radar repeater scopes. They were controlling the takeoff of a Tu-154 aircraft which was taking up a heading for Moscow...

Ye. Dogadayev, the airport's deputy chief for traffic control, who is the chairman of the permanent technical commission monitoring all the airport's ground services, says:

"Progress is being achieved through the labor of individuals. For example, Lyubov' Makarova, a fifth-year correspondence student of the Kiev Institute of Civil Aviation Engineers, came to us quite recently to work as a shift chief in the transportation organization service. Her devotion to her work quickly yielded good results. In a short time she was able to reduce as much as possible the time to seat passengers in an aircraft and load and unload baggage, and to organize trouble-free operation in the ramp mechanization area.

The command and supervisory staff of the aviation enterprise; Yu. Shevchenko, secretary of the party organization; and V. Ushkin, chairman of the trade union committee, attach primary importance to the airport collective's observance of the rules of internal division of labor.

Among those named to me as outstanding workers in the ground services is Controller Aleksey Vasil'yevich Artemov, a veteran of the Great Patriotic War and holder of many combat decorations. They also include Valentina Pushkar', Lidiya Gorbacheva, Sof'ya Gladkaya and Lyudmila Khudobina of the registration group, Galina Smirnova and other transit dispatchers. They accommodate thousands of passengers during the spring and summer period.

Operation of the Anapa Airport is being improved every year. Thus, the aircraft are being replaced by faster and more comfortable ones, and construction of buildings for the Aeroflot branch in the center of Anapa, which are original in architectural design, is being completed.

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1ST DEPUTY RAILWAYS MINISTER ON RECENT SECTOR WORK

Moscow GUDOK in Russian 1 Jun 84 p 1

[Article by GUDOK correspondent I. Kokoulin: "Transportation: Tasks of the Day--A Press Conference in Moscow"]

[Text] A meeting of Moscow journalists took place with First Deputy Railways Minister V. N. Gin'ko. He talked about the results of railway transportation labor recently and tasks on providing for summer hauling of passengers and products of the agroindustrial complex and the 1984 harvest in light of decisions of the April, 1984 Plenum of the CPSU Central Committee.

Utilization of the sectors' railcars, locomotives and traffic capacity has improved last year and for 4 months of the current one. The railway workers fulfilled their commitments in accordance with the increase in labor productivity. More than 13 million tons of additional freight was shipped for the 4 months.

Comrade Gin'ko emphasized that workers of the capital's main line made a considerable contribution to the development of competition for increasing the weight of the trains. This initiative found wide dissemination in the railway network. The average weight of a train was increased by more than 80 tons.

Recently the Muscovites came forward with a new initiative: to reduce railcar layover for loading operations by 1 hour. Calculations indicated that if this initiative is disseminated everywhere, then it's possible in a year to load an additional 1 million cars and ship an additional 50 million tons of national economic products.

A great deal of attention is being devoted to the shipment of products in accordance with the products list. With the exception of lumber, the intensity in shipments has been eliminated for a whole series of sectors of the national economy. Unfortunately, the freight plan according to this view isn't being fulfilled. The situation has improved at ports and transshipping points. It's true the MPS [Ministry of Railways] is worried about the accumulation of several thousand cars at the port of Osetrovo. A tenth of the rolling stock is being unloaded here for days.

Passenger turnover is growing steadily. During the third year of the five-year plan in comparison with 1982, it increased by 3.9 billion passenger kilometers.

The number of people who annually use the services of railway transportation approached 4.2 billion. This is roughly equal to the number of inhabitants on our planet.

The level is increasing for fulfilling the traffic schedule of passenger trains. For example, as of 28 May it was fulfilled by 96.2 percent. Eight railroads and among them the Transbaykal, the Dnepr and the East Siberian let passenger trains through precisely according to schedule.

During 3 years of the 11-th Five-Year Plan large terminals were put in operation at 11 stations and old ones were renovated. Thus in Moscow the Belorusskiy, Paveletskiy and others are being renovated.

The railroads are receiving a considerable number of passenger cars and electric and diesel trains. The passenger economy is being equipped more and more with the latest equipment and the delivery of modern ticket-printing machines, automatic vending machines, automatic information and other technical facilities is increasing.

Prior to the beginning of summer hauls at the Moscow center, transition was completed of all preliminary booking offices to equipment of the "Ekspress-2" system. Since 15 May the terminals of this system have begun to work at 4 booking offices of Leningrad's central railway bureau. Incorporation of the "Ekspress-2" system at Leningrad, Kiev and Sverdlovsk is stipulated in the current five-year plan.

The quality of passenger hauls is increasing. The designation of additional trains is stipulated in the present summer schedule.

Products of the agroindustrial complex comprise 19 percent of the entire volume of freight shipments being accomplished by rail transportation. The complexity consists in the seasonal nature of these shipments. Seeds, fuel and fertilizer are taken to their appropriate place at the beginning of the year. Then it's the motor vehicle and agricultural equipment. And it's the products of the kolkhozes and sovkhozes during the strenuous time of crop harvesting.

Cars for loading of seed are being supplied in priority order completely according to submittal. The loading plan for fertilizers is being overfulfilled.

The first deputy minister noted that there are shortcomings and he answered the journalists' questions.

Participants in the discussions were keenly interested in the prospects for deliveries of new rolling stock to rail transportation, and particularly of the eight-axle freight cars with structural changes. They asked in particular whether the fact that the passenger servicing organization is dispersed among various chief administrations hinders matters. This question has been discussed already at the MPS, but it hasn't occurred as feasible to isolate the passenger economy into a separate sector since it's difficult to divide the management of train traffic, as well as to separate into individual units the stations and depots that service both freight and passenger hauls.

For the time being in the networks the positions of deputy chiefs of railways and passenger haul departments were introduced in order to concentrate management of this matter in the same hands. By way of an experiment a cost accounting passenger sector was created in the Mineral'nyye Vody department.

The question of "doubles" was raised in a pointed manner. The discussion participants were interested in the reasons for such an occurrence. B. I. Torba, chief of the central passenger administration, gave a detailed explanation of this. Deputy Chief of the Moscow Railroad B. N. Ashikhin answered the question of when the long component passenger trains will be travelling from the Moscow center.

The operation of the "Ekspress-2" terminal for filling out tickets was demonstrated for the journalists and they were told about the advantage of this innovation over the "Ekspress-1" system.

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DESIGN APPROVAL FOR NEW LENINGRAD METRO STATIONS

Leningrad LENINGRADSKAYA PRAVDA in Russian 12 May 84 p 4

[Article by V. Tarasenko: "Stations of the Pravoberezhnaya Line"]

[Text] Yesterday the Leningrad city building council discussed and basically approved the architectural designs of the stations and entrance halls for the starting sector of the metro's new Pravoberezhnaya line that will be put in operation next year.

The length of the first sector of the Pravoberezhnaya line is more than 6 kilometers. Four stations will be accommodated here. Let's go along with V. G. Khil'chenko, architectural department chief of the Lenmetrogiprotrans [Leningrad Institute for the Planning of Metro Transportation] institute, for a short trip on this line and we'll find out how the new metro stations will be.

Valeriy Grigor'yevich relates: "The first metro station "Ploshchad "Aleksandra Nevskogo II" [Alexander Nevskiy II Square] will be situated at various levels next to the existing station and will be joined with it by a connecting corridor and escalators. The new station also will receive its own exit to Chernoretskiy Lane. Then the entrance hall erected there will be incorporated into the new public building. Along with the 'Moskva' Hotel it will form the main entrance to Nevskiy Avenue from the direction of the Alexander Nevskiy Monastery.

The theme of the heroic past that is associated with the name of the legendary general Alexander Nevskiy is a main one in the architectural decor of this metro station. The metro entrance hall already resembles the tent that earlier was pitched without fail for the general before the beginning of a battle. It will be covered with spatial designs developed by specialists of LenZNIIEP [Leningrad Zonal Scientific Research and Planning Institute for Standard and Experimental Planning of Residential and Public Buildings]. Having descended below on the escalator, the passengers will find themselves in an ancient Russian fortress city. This likeness will add white stone arcades that extend along both sides of the platform. Lamps that illuminate a snow-white arch will be mounted in them. The track walls will be lined with decorative golden aluminum. The architectural authors at the LenNIIproekt [Leningrad Scientific Research Institute for Planning] institute are planning to place a sculpture of Alexander Nevskiy at the end of the station. The planning for the underground entrance hall of this metro station was performed at Lenmetrogiprotrans.

The next station is "Krasnogvardeyskaya"["Red Guards"]. It is situated at the location where Krasnogvardeyskiy and Zanevskiy Avenues intersect. The entrance hall of this station is underground. It is envisioned placing in it coin-operated telephones, a box office, shops, and a considerable area set aside for them. A system of crossovers will connect the entrance hall with both avenues and the street car stops. When the Lenmetrogiprotrans institute authoring architects of this complex--the entrance hall, the crossovers, and the station itself--were designing its appearance, they used the theme of the struggle of the revolutionary Petrograd working Red Guards to establish soviet power. Reddish marble was selected for the station's wall facings. The floor will be made of light gray granite with the inclusion of small slabs that simulate paving blocks. It is intended to suspend seven circular metal chandeliers along the axis of the arch (this station will be single-vaulted also like the two latter ones--"Ladozhskaya" and "Prospekt Bol'shevikov" ["Bolshevik Avenue"].

The "Ladozhskaya" station is being built in the area of the former Dolgorukov cottage where the new Ladozhskaya railway station will be constructed in the future. Its underground entrance hall was decided in an extremely simple manner because subsequently it will be incorporated into the railway station building. The Lengiprotrans architects dedicated their work to those who fought and worked on the road of life during the rigorous years of the Leningrad blockade.

The last station of the first sector of the Pravoberezhnaya line--"Prospekt Bol'shevikov"--is situated nearby the intersection of the same name and Kollontay Street. In designing it the LenNIIproekt architects selected as the leitmotif a theme that recounts the activities of V. I. Lenin and his comrades-in-arms during the period of the Great October Socialist Revolution.

At the station the walls covered with light gray granite serve as a support for the snow-white arch. It's as though it is comprised of three parts that separate two strips of lamps. The floor was composed of granite slabs and at the end a monumental composition will be set up that reflects the solidity and unity of the ranks of the Bolshevik's Leninist guards. The station's underground entrance way--round in the plan and with a large luminous abatjour--that was developed by the Lenmetrogiprotrans architects later on will be placed where they'll be laying out a large square. Convenient approaches to it will be set up not only from Bolshevik Avenue and Kollontay Street, but from two new main streets that they're faced with building in this area.

So the architectural plans of the first four metro stations of the Pravoberezhnaya line were approved. Now the matter is up to the builders. But work on new plans is continuing at the Lenmetrogiprotrans institute. The blueprints are being prepared for one more station of the Pravoberezhnaya line-- "Krasnyye Komissarov" ["Red Commissars"]. It will be situated at the intersection of Bolshevik Avenue and Dybenko Street. Then the Pravoberezhnaya line will continue to the center of the city. It is intended to build three stations on this sector: "Ligovskaya" (at Transport Lane), "Vladimirskaya" and "Ploshchad' Mira" ["Peace Square"] next to the existing metro stations.

In addition to the Pravoberezhnaya, right now documentation also is being prepared for continuation of the Moscow--Petrograd line from the "Udel'naya" station to the north. Two stations are envisaged here--on Engel's Avenue where it intersects with the Vyborg Highway and Enlightenment Avenue.

A little time will pass and the new metro stations will fling open their doors in a hospitable fashion to passengers of the fastest municipal transportation.

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CSO: 1829/309

IMPROVING RAIL TRANSPORT IN TURKMEN SSR

Ashkhabad TURKMENSKAYA ISKRA in Russian 5 Jun 84 p 2

[Article by TURKMENSKAYA ISKRA economic reviewer V. Filatov: "Transportation and Production"]

[Text] Transportation, and first and foremost rail, is of enormous importance in the development of our economic system. The fulfillment of plans and socialist commitments depends to a great extent on its efficient, smooth-running and uninterrupted operation.

A great deal was done in our republic for improving the operation and complete development of rail transportation. Its material and technical base was strengthened and operating activities were improved. The implementation of comprehensive measures allowed department collectives of the Central Asian Railroad to successfully cope with the growing volume of shipments. During the years of the present five-year plan freight turnover has grown by 14.6 percent, labor productivity has risen by 3.8 percent, and average daily unloading has increased considerably.

This year the workers of the steel main lines made a successful start. More than 200,000 tons of national economic freight over and above the plan were shipped during the 5 months. During 1983 for the first time a reduction in railcar turnaround time of 2.4 percent was achieved at the Ashkhabad railway department--winner of the all-union socialist competition. The average weight of a freight train here grew by almost 6 percent and the railcar static load increased. These successes are a result of growing initiative and peoples' creative attitude towards matters.

Experience shows that, as a rule, in sectors where the leading role of communists and the proper placement of them is provided for, economic, educational and social matters are being resolved in a comprehensive manner, and commitments and plans are being fulfilled successfully. That's just how matters stand in collectives of the Ashkhabad locomotive depot; Krasnovodsk and Tashauz stations; Krasnovodsk railcar depot; track sections of the Kazandzhik and Bezmein stations; and the Krasnovodsk, Mary and Chardzhou signalling and communications sections.

The initiative of the Moscow railway workers in driving heavyweight and long component trains is finding broad support in the republic. Thanks to this, last year in comparison with 1980 the average weight of a freight train increased by 60 tons. The experience of driving superheavyweight trains is being assimilated

in a confident manner. Workers of the Chardzhou and Mary railway departments piloted freight rolling stock with a weight of more than 10,000 to 15,000 tons in honor of the all-union Leninist communist Saturday. And on the eve of Victory Day the Chardzhou workers set a new record--they drove rolling stock the weight of which reached more than 31,000 tons. Workers of the Ashkhabad department began to practice driving the duplicate empty rolling stock. All these innovations help to accelerate the delivery of national economic freight according to destination and to raise considerably the utilization efficiency of diesel locomotives and railcars.

It goes without saying that there are successes in the operation of rail transportation. However, while analyzing the activities of the sector workers during the last months of the year, it becomes clear that the resources and reserves for raising production efficiency are still being used in an insufficient manner. Tasks for diesel locomotive and railcar productivity are not being fulfilled. The freight turnover plan isn't being fulfilled at the Chardzhou railway department. Rolling stock layovers were excessive at technical stations and for loading operations.

At the December, 1983 Plenum of the CPSU Central Committee it was noted that in transportation there are more reserves and unused resources than anywhere, and which it's possible to set in motion in short time frames. The elimination of inefficient cross hauls, which cause great damage, is of utmost importance under the conditions of our republic. For example, take the transporting of crushed rock, bricks and other building materials and structures. They're being delivered from Ashkhabad to Krasnovodsk, Mary, Tedzhen and Bayram-Ali while at the same time the very same cargoes are bound the other way. And how many reroutings occur in the opposite direction! For example, last year over 7,000 railcars, and on which enormous resources had been spent, were rerouted to 3 railway departments. First and foremost in this case the enterprises of Mintorg [Ministry of Trade], Minzag [Ministry of Procurement] , Minmyasomolprom [Ministry of the Meat and Dairy Industry], and Gossnab deserve serious reproach. Their managers have already been criticized more than once for similar poor management, but, as is evident from the results of 5 months, the freight rerouting continues. Meanwhile, efficient and comprehensive planning of freight deliveries will make it possible to sharply reduce shipping costs, to free hundreds of railcars, and to save a considerable amount of fuel and energy resources. It's necessary as well to regulate the through-freight organization of cargoes being shipped. As a matter of fact, practice indicates that freight is delivered three times faster if it proceeds via the route from the dispatch station to the point of destination.

A large reserve for improving the use of rolling stock is a reduction in layovers for loading operations on the belt lines. There are a lot of enterprises and organizations the managers of which show unceasing concern about mechanizing loading and unloading operations. The facilities and warehouses here were put in order. The Ministry of Land Reclamation and Water Resources is showing the lead in this case. Railway belt lines were built to plants within the jurisdiction of Tashauz and Chardzhou. The Ministry of Agricultural Construction laid a steel track to the Dzhu-Dzhu-Klu station. The loading and unloading fronts are equipped with gantry cranes and the necessary loading and unloading mechanisms. And the railcars don't stand idle for an excessive amount of time.

However, if one examines this matter on a republic scale, then the state of affairs is no cause for joy. The average railcar layover on belt lines is overstated by 35 percent against the norm, and tens of thousands of railcars over and above the norm have stood idle since the beginning of the year. As before, the Ministry of the Meat and Dairy Industry and the Ministry of the Fruit and Vegetable Industry are among those who are holding on to rolling stock for a long time. While getting off with fines, and with the tacit consent of the sector headquarters, their managers aren't taking effective measures for improving transportation shops, organizing round-the-clock operations for brigades and loaders, and supplying them with good mechanisms and equipment.

A great deal also depends on the railway workers themselves. Matters for efficient use of fixed production capital and the highly efficient operation of locomotive and railcar stock must be first and foremost in their center of attention. However, the technical condition of diesel locomotives doesn't always provide for stable operation of them. Unfortunately, cases aren't infrequent when trains that have been formed stand idle at the junctions while waiting for locomotives.

For this reason prolonged halts of the trains occur at the intermediate stations. All this is evidence of miscalculations in organizing production, the nonobservance of repair deadlines for diesel locomotives, and low industriousness. Life dictates the necessity to intensify educational work among the locomotive brigades and to lift up the role of the engineer as the central figure in railway transportation.

Railway stock, the technical condition of which leaves much to be desired, requires particular attention. The question pertains to the fact that far from all clients show concern for maintaining railcars and repairing them in a timely manner. The Ashkhabad plants--the electrical engineering one and the one imeni 20th Anniversary of the Turkmen SSR--are showing the lead in a proprietary attitude towards rolling stock. In accordance with the experience of the Moscow enterprises, last year they repaired more containerized cars by themselves than were stipulated by socialist commitments. Forty-four enterprises of the republic pledged to repair rolling stock. Last year they repaired 2,760 railcars and 2,090 containerized cars. And if all enterprises would demonstrate such activity in this matter, then the requirements for railcars would be more fully satisfied.

Last year the collective of the Ashkhabad production association "Turkmendorstroyindustriya" [Turkmen Railway Construction Industry], and on whose account there's the largest quantity of damaged rolling stock, pledged to repair 500 railcars, but this good intention remained on paper. A lot of railcars were damaged by workers of the Saganly claystone quarries of "Glavkarakumstroy" [Main Administration for Kara Kum Construction] and the Ministry of the Construction Materials Industry, but they didn't repair a single one.

The experience of the Moscow enterprises, who pledged to dispatch each railcar and containerized car only in good working condition and which were repaired by themselves as well, must find the broadest dissemination in the republic. It's necessary to strive for so that the repair of railcar bodies may become an

integral part of the industrial process in transportation shops of all large enterprises that use the services of rail transport.

The main thing in the operational work of the transportation assembly line is the efficient use of rolling stock and first of all freight cars. And strengthening the interaction of railway subunits [podrazdeleniye] with ministries and departments and with freight consigners and consignees can render great assistance in this. Life demands more resolutely passing from mutual complaints and blame to business-like cooperation and the strengthening of order and discipline in each sector.

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PLANNING FOR LONGER PASSENGER TRAINS FROM MOSCOW

Moscow VECHERNAYA MOSKVA in Russian 3 May 84 p 1

[Interview conducted by 'VECHERNAYA MOSKVA' correspondent S. Akzhigitov with Vladimir Viktorovich Kvitko, chief of the Moscow to Smolensk section: "A Longer Passenger Train"; date and place not specified]

[Text] /The day isn't far off when 24-car passenger trains will begin to ply from Moscow./ [in boldface]

V. Kvitko, chief of the Moscow to Smolensk section, related to the VECHERNAYA MOSKVA correspondent: "As is well known, the railway workers of the Moscow to Ryazan section moved the first heavy freight trains. Their experience was spread throughout the entire country. Now our section's collective already is the first one faced with organizing the movement of longer passenger trains."

/Please tell us how preparations are proceeding for this./ [in boldface]

"It's necessary to renovate the platforms and tracks at the Kiev train station for dispatching and receiving rolling stock of this kind. These operations are in full swing. Today the installation of a tunnel was completed that connects the entrance hall of the subway station with the longer platform of the train station. The first stairs were prepared as well for exit to the future platform. The brigades are beginning work for lengthening the tracks."

/Vladimir Viktorovich, and how are the railway workers preparing for servicing the passengers?/ [in boldface]

"A group of engineers from the Moscow to Kiev passenger station developed a new method for processing eight pairs of longer trains. Thanks to rolling stock of this kind it's possible to transport an additional 300,000 passengers per year. Research of passenger flows has been conducted as well. The "Ekspress-2" system is being installed at the train station. It will help to accelerate the work of the cashiers and to reduce the ticket lines."

/What kinds of electric locomotives will move the longer trains?/ /in boldface/
"The 'ChS-7' types of Czechoslovakian manufacture. Meanwhile, they're driving the usual passenger rolling stock, but in due course they'll also take the 24-car ones."

/When will their trips begin?/ [in boldface]

"The first long trains will go to Bryansk and then to Kiev. Originally the specified time frame was the spring of 1985, but, in other words, within a year. But our collective made the commitment to dispatch the first longer passenger rolling stock in January of next year."

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BRIEFS

LENINGRAD FREIGHT LINE ELECTRIFIED--Now freight trains are travelling on two kinds of traction from the marshalling yard of Shushary in the direction of Volkhovstroy. Diesel locomotives are driving the rolling stock to Rybatskiy and then electric locomotives replace them. The cars stand pending recoupling of the locomotives, and the station literally is jammed with them. A decision was made to speed up electrification of one of the intense freight lines of the Leningrad junction for increasing the traffic capacity of this important section of freight traffic under the management of the October Railroad. The first stage of this construction began yesterday. The first units of the foundations of the overhead contact system were driven in at the Kupchinskaya station. The workers and builders of Sevzaptransstroy [Northwestern Administration for Transportation Construction] concluded a contract: to perform all operations on the 18 kilometers within 3 months instead of 9 in accordance with the norm. Electric locomotives will be moving the freight trains here by Railway Workers Day. Electrification of the section will make it possible to accelerate the rail car turnover, to free 10 locomotives daily, to eliminate recoupling of the diesel locomotives for the electric locomotives, and to increase the traffic capacity of the stations. [By N. Aleshina] [Excerpts] [Leningrad LENINGRADSKAYA PRAVDA in Russian 5 May 84 p 4] 9889

VL-80R LOCOMOTIVE IMPROVED--In the future, electric locomotives of the VL-80R type also will be produced with the honored pentagon on the side. USSR Gosstandart [All-Union State Standard] has repeatedly awarded the machine the class of highest quality. The all-union NII [scientific research institute] for building electric locomotives and the Order of Lenin electric locomotive building plant, which are located in the same area, are improving the locomotive in the process of series production. The regenerative braking system for alternating current locomotives, which was first used on the VL-80R, considerably reduces power consumption. Last year alone electric locomotives of this type returned more than 80 million kilowatt hours of electrical power to the overhead contact system. [By B. Samoylov in Novocherkassk] [Text] [Moscow SOVETSKAYA ROSSIYA in Russian 22 May 84 p 1] 9889

SOVIET-FINNISH REPAIR DEPOT--Tosno. This construction project is attracting the attention of many passengers travelling along the main run of the Leningrad to Moscow main line of the October Railway. They're observing with interest how the bright building complexes are gradually appearing in the area of the Tosno station. Builders of the Finnish firm "Khaka" are erecting the new

complex where a repair depot and a rail car preparation point are housed. On 24 May they observed a "roof raising" holiday here in accordance with an old custom. A festive ceremony took place in connection with completion of the first stage of construction. While speaking at it, First Deputy Minister of Railways F. I. Shuleshko emphasized that installation of the complex is a specific example of the fruitfully developing cooperation of the friendly countries of the USSR and Finland on the principles of good-neighborliness and mutual benefits. Putting the project, which is calculated to prepare up to 500 rail cars daily for loading, in operation will make it possible to provide for intensifying shipments, and mainly of cargoes of Soviet and Finnish commercial exchange. Repair--up to 6,000 rail cars annually--also will be performed at this complex. [Excerpt] [Moscow GUDOK in Russian 26 May 84 p 3] 9889

SOVIET-ROMANIAN RAILWAY AGREEMENT--On 31 May a conference of the Soviet and Romanian border railway commission was concluded in Kishinev with the signing of a protocol. It was conducted in conformance with the Soviet and Romanian border railway agreement. The parties summed up their joint activity and discussed its prospects for the current year towards improving the shipments of goods within the scope of contracts of Soviet and Romanian trade and providing for through freight flows of other states. They also discussed matters for further expansion of packaged and containerized shipments, the delivery of perishable goods, an improvement in the utilization of rolling stock at the border stations, and improvement in the interaction of the two country's railway workers; and they coordinated train traffic schedules. [By the Moldavian Telegraph Agency] [Text] [Kishinev SOVETSKAYA MOLDAVIYA in Russian 1 Jun 84 p 3] 9889

CSO: 1829/307

MARITIME AND RIVER FLEETS

DIRECTOR ON BLACK SEA DESIGN BUREAU PROJECTS

Moscow VODNYY TRANSPORT in Russian 17 May 84 p 2

[Interview with Sergey Martynovich Nunuparov, director of the Black Sea Central Planning and Design Bureau by V. Patyk: "Contribution of the Scientists"; date and place of interview not given]

[Text] [Question] All collectives of maritime transport are preparing for the 60th anniversary of the Soviet maritime merchant fleet. Certain results are being summed up and specific measures outlined to improve the forms of the socialist competition.

We have asked S. Nunuparov, director of the Black Sea Central Planning and Design Bureau [ChTsPKB] to describe what contribution is being made by the scientists and designers to the development of the Soviet maritime fleet.

[Answer] In determining their tasks for the 11th Five-Year Plan, the bureau's collective proceeded from the necessity of aiding the navigation company in quickly mastering the commercial and technical operations of the new specialized fleet and rapidly bringing it up to the design indicators. In this context, we have devoted main attention to improving the technical operation of the medium-speed main engines, the new types of automation, navigation and communications equipment, cargo handling equipment and to creating conditions for reducing non-productive fleet stoppages.

In addition, we are carrying out innovations contained in our developments and the modern achievements of domestic and foreign science. Here we should mention first of all the new forms of maintenance. These include the moving to the operational period of certain types of repairs which at one time idled the ships at the piers of the ship repair yards, the employment of new standards for the wear on hulls as proposed by science, and the broad use of polymer glues and compositional materials in the repair and operation of ship equipment. In the bureau's portfolio also are background studies for new transport production systems, including new lighter-carrying and barge-tug systems as well as through non-transloading systems for the Danube--Dnepr and Danube--Volga.

Within the social program for the development of the Black Sea resorts, the ChTsPKB is working on the development of new types of passenger vessels. The present ones will soon be replaced by a new generation of comfortable 300-seat high-speed vessels.

At present, the economic effect from the contribution of our bureau can be described and assessed as follows: as an average over the last two five-year plans for each ruble of expenditures going into the elaboration of the plans, the navigation companies which introduced them received at least 400 rubles of profit.

[Question] Sergey Martynovich [Nunuparov], what contacts have been established between the ChTsPKB and analogous Soviet organizations and foreign firms?

[Answer] It goes without saying that the introduction of such a broad spectrum of innovations is inconceivable without serious reliance on science and without fruitful collaboration with scientists working in our and related sectors.

For the 11th Five-Year Plan, the ChTsPKB has already concluded more than 70 contracts with scientific organizations, including one-half on an economic basis and the remainder on principles of creative collaboration. The range of collaboration is rather broad, including the head scientific research institutes and VUZes of the Minmorflot [Ministry of Maritime Fleet], the scientific research institutes of other departments and state committees, the institutes of the USSR and republic academies of sciences. There has also been a fruitful exchange of ideas and developments with foreign scientific and design organizations. Among these we would mention the Bulgarian water transport institute, the Polish NAVICentrum Design Association and the Design Bureau of the GDR Shipyards.

[Question] Is your collective working under orders from the fleets or is it itself responsible for various ideas?

[Answer] Our activities are so closely tied to the activities of the navigation companies that it is at times hard to establish where our work ends and the work of the fleet specialists starts. You will meet co-workers from the bureau both at the ship repair plants and ports, they make practice runs on the vessels, in a word, they are in constant contact with the maritime transport specialists.

[Question] Frequently one hears complaints of poor-quality plans. Does this apply at all to your bureau?

[Answer] The quality of plans is a comprehensive concept. Here I would isolate two main aspects. On the one hand, this is the quality of the ideas established in the plan or, in other words, the scientific and technical level of the development. In this instance there are completely objective methods for assessment and comparison with the best domestic and foreign models. On this level things are rather good for us. Over just the last 5 years from our plans we received 142 certificates of invention, 7 foreign patents while the FRG has been sold a license for a bale-making machine and talks are underway for selling other licenses. Just in 1983, the developments of the ChTsPKB received 18 medals from the VDNKh [Exhibit of National Economic Achievements].

However, there is also another aspect to design quality and this is apparent only in the immediate implementation of a design. On this level we actually, and unfortunately, have received criticism from the manufacturers.... There are many reasons from the errors of the designer in the plans to a change in the delivery of preassembled equipment or the absence of the essential material at a crucial moment at the manufacturing plant.

In order to exclude or minimize design errors we have introduced our own comprehensive system of quality control. We have worked out 46 standards which should erect a barrier against any type of reduced quality.

[Question] Sergey Martynovich, how much time passes from the working out of a plan to its introduction into production?

[Answer] In comparison with the previous five-year plan, we have succeeded in shortening the average statistical time by 16 percent and at present this is 1.6 year. This is an average figure. There are plans which are carried out within a year but there are also those the introduction of which is drawn out for 3 or 4. In analyzing either situation, it can be concluded that a great deal depends upon the client, his readiness and, certainly, his capabilities.

In this regard we are putting great hopes on the decree of the CPSU Central Committee and the USSR Council of Ministers "On Measures to Accelerate Scientific and Technical Progress in the National Economy" and which substantially increases the responsibility of the economic leaders for introducing technical innovations and will lead to the establishing of a series of economic mechanisms which will significantly accelerate this process.

[Question] What determines the direct tie between science and production? In your developments do you consider the innovation proposals of the production workers?

[Answer] The ChTsPKB is the developer and participant in carrying out comprehensive specific programs on various levels and which closely bring together both scientific and production tasks. As for the innovation proposals, they certainly are considered in working out various plans. All proposals which contain fundamentally new technical solutions are examined.

For example, in collaboration with inventors from the Novorossiysk Port, a mechanized line was developed for assembling wooden pallets which are widely being introduced in the ports of the MMF [Ministry of the Maritime Fleet] and other departments. From an invention of co-workers at the Belgorod-Dnestrovskiy Port, a log squarer was designed and much else.

[Question] But what about the subsequent life of the plan, when it has left your bureau?

[Answer] After introduction what survives is essentially not the plan but what was conceived of in it and the viability of this life is determined by the degree to which the client has used it. In turn the developers endeavor to disseminate their offspring as widely as possible into those spheres where it can be useful and bring an additional effect. For example, many of our developments are being successfully utilized in related sectors. Moreover, with series output of the articles following our plans we carefully follow up and collect data on their operation, we generalize the comments of the production workers and then at the dates stipulated by the legislation we modernize the plan considering these comments and the new level of technology.

[Question] The ChTsPKB is the head organization of the MMF for the problems of environmental conservation. What are you now working on in this area?

[Answer] We have worked out and the leadership of the ministry has approved a sectorial comprehensive specific scientific-technical program which determines all the activities of the MMF on these questions up to 1985. We are also working out programs for more distant periods.

We have established and are carrying out plans to bring the transport fleet into accord with the demands of the International MARPOL Convention. All our ports in the nation are being provided with oil and rubbish collectors, bilgewater collectors and boom barriers. We have begun operating the multipurpose expeditionary environmental vessel "Svetlomor," a ship bilgewater separator is being produced and a series of organizational and production documents has been published on combating oil spills.

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MARITIME AND RIVER FLEETS

CHIEF ON WORK OF LENINGRAD DESIGN BUREAU

Moscow VODNYY TRANSPORT in Russian 22 May 84 p 2

[Interview with Viktor Nikolayevich Rybin, chief of the Leningrad Central Planning and Design Bureau, by A. Cheprasov VODNYY TRANSPORT special correspondent: "Minimum Expenditures and Maximum Reliability"; date and place on interview not given]

[Text] Among the leading scientific and design organizations of the Ministry of Maritime Fleet [MMF] one of the first places in terms of the practical contribution to the technical progress of maritime transport is held by the Leningrad Central Planning and Design Bureau [LTsPKB] which was founded under the decree of the USSR SNK [Council of People's Commissars] in 1935. From the very outset it has been specialized in working out the technical documents for modernizing ships and has designed new ones, among which is the "family" of standardized seagoing tugs and large transport vessels.

In 1941, more than two-thirds of the bureau's specialists left for the army, the navy and the people's militia units. In beseiged Leningrad, a small collective worked out the plans for barges to be used on the Lake Ladoga "Lifeline." In them the beseiged city received food and military freight while more than 1.7 million tons of cargo and more than 110,000 persons were transported out of the city. During the postwar period, the bureau has been concerned with the modernization and development of the fleet. At the same time, new plans were created for seagoing tugs, cargo and passenger vessels.

At present, a total of more than 4,000 different type vessels have been built under the plans of the LTsPKB. In the last 4 years, the creative efforts of this collective have been recognized by two state prizes and three prizes of the USSR Council of Ministers.

Here we offer to our readers an interview by our special correspondent A. Cheprasov with the chief of the LTsPKB, Viktor Nikolayevich Rybin.

[Question] How is your collective carrying out the party and government decisions to increase the creative output of the specialists and the quality of their engineer solutions?

[Answer] First of all, we are establishing a situation of creative exactingness and personal responsibility for the assigned job. We are working, as they say, with minimum expenditures on construction and operation but not to the

detriment of quality and reliability. For example, we have developed types of ships for coastal shipping and vessels for roadstead unloading of tonnage on an unequipped shore. Here we have assigned a major role to the computer with terminals as these substantially help in optimizing and raising the quality of the technical decisions. Here work is being carried out in three areas: the automating of design and engineering work, information retrieval systems and the solving of primary problems in the area of planning, bookkeeping, personnel and so forth.

The introduction of the computer has now provided us with a savings in engineering design of around 20-25 man-years a year with an effect of 400,000-500,000 rubles.

[Question] What difficulties are there on the path of introducing new technical ideas?

[Answer] The realization of new ideas requires, as a rule, new materials and equipment. For this reason we spend a lot of energy and time to reach agreement with the industry of various departments on the placing of our orders. This problem is acute and urgent also for the ships under series construction. Their supply with mechanisms, equipment, cable products and other materials is extremely unsatisfactory and takes up to 20 percent of the working time of the engineer and designer personnel for locating and approving various substitutes.

When a vessel has been accepted and its test operation starts, then a new psychological barrier appears among the sailors. For example, the Far Easterners, without having properly tested the air-cushion platform (PVP-40), have stated that such equipment is of no use to them.

The navigation companies, as a rule, to put it mildly, show a restrained attitude toward the introduction of innovations, reserving their position for the future. In principle this is wrong.

[Question] What economic effect has the work of your collective produced in maritime transport?

[Answer] According to statistics, we produce more than 6 rubles per ruble of expenditures. Just the ships for coastal shipping consisting of 11 types of vessels have provided the navigation companies with an annual economic effect of around 30 million rubles, a savings in metal of around 35,000 tons and a reduction in labor expenditures (ship and shore personnel) of 230,000 man-months over the five-year plan.

In the area of increasing reliability, repairability and reducing the labor intensiveness of maintenance on the newly developed vessels and equipment for them, good results have also been obtained. Here labor expenditures have been reduced in operations by approximately 3,500 man-hours a year as an average for each new vessel received in the fleet.

Upon the initiative of specialists from the LTsPKB, the problems have been posed and successfully resolved of replacing the existing ship electric drive with the general industrial modification based on the 4A-OM type of electric motor. This

will provide the MMF with more than 2 million rubles of savings just from the price difference. Metal intensiveness will be reduced by 1.5-2-fold and expenditures will be reduced on annual maintenance for each vessel. Motor life between repairs will approximately double and each year around 50,000 tons of fuel will be saved due to the better energy indicators. And a new series of ship centrifugal pumps will make it possible to reduce labor expenditures in maintenance by 3-4-fold and increase motor life between repairs by 2.5-fold.

Here I have not said anything about the effectiveness of the modern transport and icebreaking vessels which comprise the main core of the USSR maritime fleet and handle the basic volume of shipments. These have also been developed with the active participation of LTsPKB specialists.

In a word, for us as before the primary tasks are to increase the creative potential, organize work and strengthen discipline, all that was mentioned at the recent plenums of the CPSU Central Committee.

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MARITIME AND RIVER FLEETS

SHIPPING COMMO IMPROVEMENTS URGED FOR LOWER VOLGA AREA

Moscow VODNYY TRANSPORT in Russian 19 May 84 p 2

[Article by A. Kusaliyev, chief of the Astrakhan Communications and Radio Navigation Center of the VORP: "A Capricious 'Overhead Line'"]

[Text] As the river fleet has received new vessels and the transporting of passengers and national economic cargo has risen, it has become evermore difficult to control the transport process on the water arteries. At present, this can be effectively directed only with the most advanced types of dispatcher communications. For this reason, our sectorial communications has recently been developing intensely.

Substantial changes have also occurred on the section of the Lower Volga which is serviced by the Astrakhan Communications and Radio Navigation Center of the Volga United Shipping Company [VORP]. In the delta we have begun operating an unique system of radio and wire communications. This is constantly being improved. Recently a tall radio mast was installed with zonal remote controlled USW radios making it possible to cover the "dead areas" for vessels equipped with the old types of radios. At the Astrakhan enterprises, the old telephone exchanges are being replaced by modern coordinate ATS [automated telephone exchange]. This year the more advanced central "Reka" [River] station will be put in service. This will make it possible to increase the efficiency and quality of local communications, it will improve the equipment operating conditions and broaden the possibilities for the further development of the telephone network.

But still the return from the funds invested in modernization has been insufficient.

At times all the advantages of the modern exchange equipment are nullified by the lack of high-quality connecting lines and channels between the ATS. A significant portion of the sectorial cable, and of the most different types, was laid in Astrakhan 40 and more years ago. The attempts at a major overhaul on the network which is more than 150 km long have been ineffective due to the lack of modern multiplexing equipment and cable products. The reconstruction has been complicated by the clay salt-marsh soil with deep subsoil water. This is extremely corrosive on the cable lines. Cable in a plastic or aluminum wrapping rapidly wears out and it is not rational to lay it. But there is no other solution as we are virtually unable to receive cable in a secure lead casing.

The problem of reconstructing the interexchange communications is urgent not only for us in Astrakhan but has also assumed sectorial significance. The main problem is that in successfully solving the problems of modernizing individual installations, the communications workers act in isolation from one another, without an overall integrated task.

We have endeavored to keep the main line assigned to us in good condition, considering that it handles not only the long distance communications but also controls the line USW radios and carries the radio and wire calls to the ships. However, for reasons beyond our control it at times stands silent. Sometimes for several days running. Particularly unstable are the channels on the sections Astrakhan--Kuybyshev and Astrakhan--Gorkiy and these connect the lower reaches of the river with the staffs of both Volga navigation companies. Just during the first quarter of this year the downages were, respectively, 387 and 204 hours.

The frequent interruptions in communications are the total of all failures on the individual sections of the run which is more than a thousand kilometers. And one-tenth of the downages is not due directly to the damage of the main line.

Chiefly the overhead lines cease operating because of bad meteorological conditions. The failures of the overhead line at times are due to the effect of the high voltage power transmission lines and other electrical engineering installations. The technical capabilities of the overhead line for multiplexing the communications channels are limited. The higher their frequency the more sensitive the mainline becomes to various sorts of atmospheric interference.

In realizing how negative are the consequences in disrupting communications for the leadership of transport operations and for the normal activities of the enterprises, the sectorial communications workers in the interests of their own users have organized bypass connecting lines and channels and have sought out other opportunities for satisfying their needs. For example, we have a contract with the communications workers of the gas industry, the petroleum industry, the railroad workers and the Ministry of Communications. These contracts consider the possibility in critical situations of seeking help from the workers of the long distance exchanges of other sectors. But in practice it is not always easy to "break into" a different and already overloaded line. Particularly as a majority of the departments have the same undepend[illegible]e overhead approaches to Astrakhan which are subject to the caprices of the w[illegible]her.

The overhead lines--the yesterday of communications--also have a negative impact on the work of the line radios which in this instance are not provided with high-quality remote control channels needed, aside from operational hook-ups, for collecting various information from the ships and from the ports and transmitting it to the sectorial computer centers. The dispatcher system of the navigation companies and ports, the ship pilots and leaders of the enterprises are also in an acute need for a more reliable communications system. In a word everything points to the fact that the time has come to lay a cable line for the sector on the nation's main water artery.

The economic advisability of a cable line is also backed up by the need to increase the efficient operation of the modern equipment employed on the spot. Particularly promising, in our opinion, is a cable line on the leg of Astrakhan --Kuybyshev as this would make it possible to substantially improve radio and wire communications along the entire Lower Volga.

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MARITIME AND RIVER FLEETS

WATERWAY TRANSPORT DEVELOPMENT IN MARI ASSR URGED

Moscow VODNYY TRANSPORT in Russian 5 May 84 p 2

[Article by N. Gubin, secretary of the Mari CPSU Obkom: "On the Volga Mainline"]

> [Text] The major waterway of European Russia, the Volga, rolls broadly through the territory of the southern regions of the Mari ASSR. And rushing into it from all sides are such rivers as the Vetluga, Sura, Rutka, Ilet, Bolshaya and Malaya Kokshaga....

The economic development of the Mari area has traditionally been linked to the activities of water transport. Our land, as is known, is rich in forests, but not only lumbering and woodworking depend upon water transport but all our industry as a whole. The river workers, together with the rail and motor transport workers deliver inert building materials, oil products and various equipment and mechanisms to our construction projects and enterprises. Just during the years of the last five-year plan, hundreds of thousands of tons of major national economic cargo were delivered to the republic over the waterways.

At present, the importance of water transport has increased even more. The 26th CPSU Congress has clearly pointed to the necessity of working out a long-range and comprehensive program for its development. The party obkom and the republic government view all the fundamental questions related to a further improvement in the activities of the river workers and the development of the water arteries precisely from this standpoint.

Our ports and piers are part of the nation's largest Volga United River Shipping Company [VORP]. Recently it has done a good deal to improve the work of the enormous transport conveyor on the great river. The physical plant of the navigation company has been strengthened, large-capacity sectional units and large-tonnage diesel vessels with towed units have been put into operation and new optimum cargo traffic schedules have been worked out. The fleet is constantly receiving powerful cargo and comfortable passenger diesel vessels, modern icebreakers and high-speed vessels and a progressive method is being evermore widely employed for dispatcher control over fleet traffic and port operations. In a word, a highly industrial transport system has now been developed on the Volga. The total length of the navigable waterways in the republic exceeds 300 km and with the filling of the Cheboksary Reservoir it will

increase even further as a result of the rise in the water level on the Vetluga, Sura and Rutka.

Due to the constant concern shown by the party and the government for the further development of water transport, the republic's water system in recent years has grown significantly stronger. Navigation on the small rivers has been improved and there are more piers equipped with cargo handling equipment. For passengers they widely employ hydrofoils of the "Meteor" and "Raketa" classes. All of this has helped to more fully satisfy the needs of the republic economy and improve transport services for the public; it has produced indisputable economic gains. Suffice it to say, the transporting of freight by river transport is 30-40 percent cheaper than by rail. Merely by transporting building materials along the Volga and Vetluga the republic economy was provided with tens of thousands of rubles of net profit. It must also be considered that our river piers are located in the Nonchernozem Zone of the RSFSR and their operation directly influences the fulfillment of the Food Program. It is all the more important to improve the already existing capacity and also develop new.

The appearance of the young Kozmodemyansk port has been changed. Quite recently here there was simply a lumber loading point and one solitary pier. The Kozmodemyansk workers rafted hundreds of thousands of cubic meters of lumber down the river. Now the flow of lumber has declined sharply. However, regardless of this, the volume of cargo handling and the range of cargo have been constantly growing. The roadstead here has come to life, here they have a local fleet operating on the crossings of Kozmodemyansk--Korotin, Yurino--Korotin and these daily ferry 70-80 motor vehicles and even more during the peak harvesting season, while a "Meteor" has begun delivering passengers to remote areas along the Vetluga. In a word, the port is growing and developing and its prospects are very promising.

A step ahead has also been taken by our ship repair and ship building facilities in Zvenigovo, one of the largest in the Volga Area. At present, the Plant imeni Butyakov is turning out pusher tugs, barges with a cargo capacity of 1,500 tons, fire boats, structural metal elements and so forth. A large number of cargo vessels has been assigned to the enterprise. From the very first days of the navigation season, its crews widely developed the socialist competition and have been working in a situation of a strong labor upswing. With each passing day on the fleet the movement grows stronger for an above-planned 1-percent increase in labor productivity and an additional half-percent reduction in shipping costs. The river workers are initiating practical steps to carry out this party assignment. The plan for the first quarter of the current year was fulfilled ahead of time by the plant collective for all technical and economic indicators with labor productivity rising 14 percent in relation to last year's level while product costs have declined by 0.6 percent in comparison with the plan. High results in labor have been achieved by the communists such as the mechanic G. Yakimov, the brigade leader of hull workers A. Bastrakov, the milling maching operator G. Korolev and many others.

In Zvenigovo there are many remarkable collectives. For example, the crew of the diesel vessel "Dunayskiy-57" which for 12 years now has been led by the member of the plant party committee A. Kirillov and for 4 years running has

emerged as the winner in the all-Russian socialist competition. Over the 3 years of the five-year plan, it has fulfilled four annual quotas and saved scores of tons of fuel. Here the successes have been achieved by strict labor discipline, by employing advanced production methods and by the skillful operation of the ship equipment. The communist captains of the diesel vessels OT-2055, Yu. Malinov, the "Kopanovka" G. Zakharov and many other fleet commanders are well known as excellent organizers and indoctrinators.

The navigation season in the fourth year of the five-year plan is picking up pace. The collectives of the republic's water transport center have set taut socialist obligations. The river workers are fully determined to carry out the set tasks but before this it is essential first of all to eliminate the bottlenecks and utilize the existing reserves.

Let us take the problems of developing the port system, in particular, in Kozmodemyansk. This has been carried out with interruptions due primarily to the fault of the general contractor, the Volgodongidrostroy [Volga-Don Hydropower Construction] Trust of the USSR Mintransstroy [Ministry of Transport Construction]. Each year it fails to carry out the plans for the use of capital investments. Construction on the pier wall in Yurino is also being carried out at an unsatisfactory pace.

There are also unsolved problems in equipping the piers with facilities. In the same Kozmodemyansk port, for example, in recent years the volume of cargo handling has almost tripled while the availability of highly productive equipment has virtually not increased. Here, like many years ago, there are still the same three 5-ton floating cranes. During the peak of the navigation season, the port, as they say, is "choked up" and is unable to promptly process the fleet. For mining high-quality sand from the Volga channel and for accelerating the processing of the large-capacity sections, the Kozmodemyansk workers need a 16-ton floating crane. Volzhsk, Zvenigovo and Kokshaysk also need modern cargo piers. As before, the situation is not good with the grain and other departmental piers. They are developing extremely slowly, particularly in Volzhsk, where we are establishing a major industrial center and each year hundreds of thousands of tons of freight are handled. We feel that the cargo owners must show a more serious and responsible attitude toward the construction and reconstruction of their pier system located in the Nonchernozem Zone of the RSFSR.

Passenger traffic must also be improved. Even now there is a need for more powerful and larger ferries of the R-144 class for the intense passenger traffic between Kozmodemyansk and Korotin and Kozmodemyansk and Yurino. Or take the following question. The tourists in our republic, as is known, are served by the diesel vessel "Geroy A. Golovachev." In arriving at the end point, it makes pleasure trips and also gets ready for new tourist cruises. Here frequently problems and inconveniences occur. At the moment the tourists are preparing to embark, the "Meteors" and "Taketas" pull in. The large vessel must stand off in the roadsteads and execute infinite maneuvers causing inconvenience for the passengers. For this reason the dock at Yoshkar-Ola must be provided with another pier, specially for the high-speed fleet. It would be a good idea to have additional support vessels also in Zvenigovo, Volzhsk and Yurino and the R-145 design landing ramps for the ferry crossings.

I would like to draw the attention of the MRF [Ministry of the River Fleet] to an alarming fact. The water-displacing passenger fleet is obsolete and there are no deliveries of new vessels which could replace the vessels of the OM and MO class and dependably link the local lines. The navigation company has assigned the Kozmodemyansk port to high-speed diesel vessels, however they, of course, do not solve the problem. Incidentally, the tug fleet operating in local shipments is in the same unenviable situation. Virtually all the vessels which the regional water system has are of a "R" class and consequently cannot operate under the conditions of a man-made sea. They are prohibited from entering a large body of water.

In the area of the Cheboksary Reservoir, the necessity has arisen of establishing a shore facility for the complete servicing of the fleet. In Kozmodemyansk it would be advisable to organize an affiliate of the ORS [worker supply section] of the Cheboksary port and have a floating store on the Cheboksary--Volzhsk roadstead.

For extending the navigation season and ensuring uninterrupted operation of the crossings in the early spring and late autumn, the local river workers must have a port icebreaker of the R-47 design. Also needed are a new floating shop, a caisson dock with 600-ton capacity, a treatment plant and a petroleum bunkering station.

We would again like to raise the question of reconstructing our ship repair and ship building facilities. Over the last 3 years, at the Plant imeni Butyakov they have put into operation a number of important production facilities. However, much work still remains to be done including expanding the territory of the building ways; modernizing the slip and enlarging the size of the basin, building the utilities and power system; installing new production equipment and mechanization for labor-intensive jobs. All of this is required for building the new tugs and for the high-quality repair of the ever-increasing registered fleet and the gravel-mining equipment. However, a fundamental reconstruction of the Plant imeni Butyakov has clearly been drawn out and the dates for completing many projects have repeatedly been moved back. We are hopeful that the VORP will take specific measures also for the accelerated construction of housing for the river workers and for cultural and service facilities.

A prompt solution to the problems confronting the workers of the waterways in the Nonchernozem Zone will make it possible to further raise the importance of the Volga as a highly efficient transport artery and will help the river workers to more quickly and better carry out the tasks posed for them by the 26th CPSU Congress and the subsequent plenums of the party Central Committee.

10272
CSO: 1829/298

FAR EAST FACING PROBLEMS IN LIGHTER PRODUCTION, OPERATION

Moscow VODNYY TRANSPORT in Russian 12 May 84 p 2

[Article by A. Mikhasenko from Vladivostok: "In a Mode of Professional Search"]

> [Text] Even for persons knowledgeable about the sea, the picture might seem strange: on Amur Bay among the broken ice a tug was pushing an enormous metal box in various directions. Co-workers from two Far Eastern institutes, Dal'morniiproyekt [Far Eastern Maritime Scientific Research and Design Institute] and the polytechnical, were testing lighters. They were determining the operational strength and the reliability of the structural elements under difficult ice conditions and were investigating the particular features of towing. The results of the experiments, in the opinion of the scientists, were disconcerting as it was necessary to immediately increase the lighter hull strength otherwise they would not avoid mass damage even during the first navigation season.

This was merely an episode, a link in the chain of events which formed in determining the "Far Eastern Lighter Carrier System." And this began developing long before January 1984 when the first Soviet-produced lighter carrier "Aleksey Kosygin" was launched from the ways of the Kherson Shipyard. The vessel's crew headed by Capt V. Yur'yev had to make the move to the shores of the Maritime Province. During the first days of July, having taken on board 82 lighters (a full load), the vessel will head to the ports of Kamchatka and the Far North.

There are things to do still, in the opinion of the chief of the administration of lighter and container shipments of the Far Eastern Navigation Shipping Company, V. Cherepanov, with no end of the work. And the cited example of the strength testing is a clear illustration of the well-known axiom that it is always hard to introduce something new. But in the given instance, undoubtedly, the end justifies the means.

The basic obstacles in delivering cargo to destinations on the Arctic coast and the waters of the northern rivers, said the chief of the Section for Lighter Shipments of the Far Eastern Navigation Shipping Company [DVMP], G. Mironchik, are the lack of equipped piers, the limited navigation period and bad weather

conditions. With the annual increase in cargo turnover it is becoming more and more complicated and expensive to operate according to the customary scheme of delivering the cargo up the rivers using river transport and by sea using maritime. Here trans-shipping, a shortage of tonnage and stoppages are inevitable. What will the new shipping system provide and what are its merits?

The lighter carrier possesses colossal cargo capacity. In one trip it can transport 2.5-fold more than an ordinary dry cargo vessel. The lighters can be unloaded in the roadsteads and this is particularly important with the overloading of the ports and their poor equipping. The floating containers can be processed at shallow-water piers and the rectangular shape of the lighter combined with absolute access to the cargo significantly accelerates and cheapens the processing. The lighter carrier makes calls only at several basic ports where the lighters are delivered from nearby points by tugs. The direct combined river--sea shipments which do not involve transloading are a dream both for the recipients and the shippers which has become a reality.

Also being solved are strategic tasks in the economics of transport with new cargo routes being developed and the existing ones extended without fabulous capital investments.

The benefit is obvious. The lighter carrier system is already in operation. As for now in a search mode. For example, a search for the optimum solution to many problems related to the construction of the lighters.

As a total at least three sets of them are required. The manufacturers are seven plants including the Slavyanka Sovetskaya Gavan and Nakhodka SRZ [ship repair plant].

The ship repair workers of Slavyanka have met the quota of last year and built 18 lighters. But at what a price! In parallel they have put up a specialized set of shops the equipment for which have been received at the beginning of 1982. The estimated cost of the projects was almost 20 million rubles. But the general contractor, the Primortransstroy [Maritime Transport Construction] Trust is not utilizing the planned capital investments. Although seemingly the plant workers and construction workers cannot be blamed as there have been delays in the deliveries of metal structural elements from the plants of Minmontazhspetsstroy [Ministry of Installation and Special Construction Work]. For this reason the question of whether construction will be completed this year according to the plan remains moot.

The USSR Gosplan set a quota for the Nakhodka SRZ for building lighters, the attachments for them and sea-going tugs. How was the ship building program to be carried out? The Nakhodka shipbuilders were betting on their own internal reserves. Under the leadership of an enterprising group, the building ways were modernized, a flow-position construction method was introduced while the precise and steady work of all the production units was monitored by the party committee and enterprise administration. The people worked sparing no effort.

V. Kolesnikov, an engineer at the Nakhodka SRZ, related that the lathe operator Gennadiy Shekevets, in learning of the difficulties in the shop with turning work, cut short his vacation. And each day they surpassed the norm by 1.5-2-fold!

The brigade of drill operators from the machine shop headed by the party group organizer Viktor Dimidov fulfilled ahead of time the plan for the 3 years of the five-year plan, surpassing the norm for machining the castings.

But, regardless of the true enthusiasm, the special tug was not ready on time. And in running trials, substantial design flaws were discovered.

However, it is also possible to give another example where the union between science and production was truly beneficial. To put it mildly, icing causes the fleet a great deal of trouble! And although for the lighter carrier itself icing is not dangerous, the lighters "fear" it not only from the viewpoint of the safety of navigation but also loading procedures. The problems of combating this phenomenon have been studied by many organizations of the Ministry of Maritime Fleet [MMF] including the Chair of Ship Steam Generator Turbines at the Far Eastern Higher Naval Engineer School imeni Adm G. I. Nevel'skiy.

Here is what was said by the senior science associate of the chair F. Aykashov.

"A lighter because of the icing up of the grips cannot be raised and lowered. Particularly dangerous is a 'ice plate' which can form on the underwater portion during extended standing in port during the winter. The ice can be removed manually, let us assume, from a set of lighters in 15-20 days. But then what sort of effectiveness of shipping could there be? During the winter on the territory of the Slavyanka SRZ, co-workers from the DVIIMU [Far Eastern Higher Marine Engineer School], the graduate student V. Shtrikel' and A. Shchukin and V. Dotsenko, students working on their graduation projects, carried out full-scale testing." There was the specific task of finding the most economic method. There were three ways: washing the ice off with sea water which had been heated to 80-90°. This would take just several minutes. A plan for the system employing this method will probably be introduced with the arrival of the lighter carrier. The second method in terms of mechanical effect is analogous to the first. Only high temperature gas is employed obtained from a manual portable heat generator. This was demonstrated at an exhibit of the school's scientific creativity and was of interest to the specialists in simplicity of design, compactness and outstanding performance.

The third method is based upon a vibration method. This is most promising as the ice is removed directly in the loading process. Such a unit installed on the lighter carrier would pay for itself in the initial operating period and on one vessel would make it possible to save around 330,000 rubles a year.

Questions, problems.... Technical, commercial and scientific research. They arise daily and they are inevitable. Thousands of people are involved in solving them including workers, engineers and leaders of the navigation company. But there should also be the firm rule of seeing the long run behind the difficulties of the current moment. And to work for this future.

In the Vladivostok maritime port the first stage of a collection-settling base has been built and this consists of two pontoon floating piers. Similar bases will be built this year in Ust-Kamchatsk, Egvekinot, Provideniya and Lavrentiya. They have worked out the plans, agreements, the rules for cooperation among the involved parties, the lighter bill of lading and the operating documents. A

special word must be said about the automated system of tracking the movement of the lighters. It as yet is in experimental operation. But how essential it is! The bitter lessons of the past, when containers were still a wonder in the Far Eastern Basin, precisely the absence of such a system involved significant losses. We are certain that with the lighters this story will not be repeated.

Not much time remains until the first Soviet-produced lighter carrier "Aleksey Kosygin" will drop anchor in the roadstead of Zolotoy Rog Bay. It will be close in port for it as the vessel is 262 m, 1.5-fold more than the largest vessel in the navigation company! The second (if construction can be called the first) stage of introducing the lighter carrier system is beginning. Time is rushing past. In Kherson the same type of lighter carrier the "Sharaf Rashidov" has been laid down and the ship builders of Kerch have begun building a nuclear-powered giant.

The mode of a professional search is entering the crucial phase of direct operation. And the end result will become the basic measure of effectiveness.

10272
CSO: 1829/298

FISHING FLEET DEVELOPMENT

YAK-40 PATROLS USED TO SPOT FISHING VIOLATIONS

Moscow VODNYY TRANSPORT in Russian 12 Jun 84 p 4

[Article by L. Kraynova in Petropavlovsk-Kamchatskiy: "Yak-40 Ascends on Alert"]

[Text] /"The green sea of the taiga is singing about something under the wing of the aircraft." I look out the window and under the wing of our aircraft at the raging sea with waves that are heaving indomitably upwards.

Today the Yak-40 is performing a responsible mission--a flight around the 200-mile zone in search of violators and illegal fishing vessels in the restricted areas and waters of the Far East./ [in boldface]

Besides the pilots, the state inspector of "Kamchatrybvod" [Kamchatka Fishing Administration] Vladimir Burkanov, who also is supervising the flight, is on board the aircraft. It's precisely he who is giving the crew commander the flight route, selecting the altitude, and computing the time. In contrast to an ordinary passenger one, this trip doesn't have a definite flight route. Everything here depends on the most unexpected circumstances. Within a few seconds, and in spite of the aircraft's speed, the inspector must be able to get a fix as much as possible on the violator's distinguishing markings: the side number and the name of the vessel. And, if required, to give the navigator the command to repeat the aircraft's pass from the necessary direction, and at any minute the pilots must be ready to assume the required altitude for this.

But for the time being a calm situation reigns in the cabin. Vladimir Burkanov explains the forthcoming flight route to the crew commander. The flight is being performed in accordance with a special mission of "Kamchatrybvod" where the alert signals were received. There are violators in the Sea of Okhotsk.

Vladimir Burkanov gives instructions to the pilots: "We're departing for Ust-Bolsheretsk. We'll fly over the area of the violators' presumed location."

It's 1,800 meters above sea level. Soon the Yak-40 descends to an operating altitude--300 meters. "What are the weather conditions today?"

Vladimir replies: "For the time being they're good. There are low clouds over the sea. But right now the sun is heating and they'll disperse or ascend higher where they can no longer hinder our work."

But now Volodya's face is becoming anxious. The radar is painting a vessel.

We dive into the abyss of clouds. The aircraft begins to hurl from side to side. There's a gale below. We passed through the ceiling of the cloud cover. We're turning around in search of the violator. He must be somewhere under us. All the equipment--the "Zenit" camera and the "Yupiter" lens--are prepared for "combat."

Now a fishing trawler is clearly visible already in the window. A click of the "Zenit" and Burkanov has photographed the violator.

The inspector addressed those present in the cabin: "Look and see whether it has a name of some kind. It's advisable to remember the numbers."

The aircraft turns sharply to the right and makes one more pass over the unknown trawler.

But the violator has a rich arsenal of "protective means." Knowing about the existence of the fish protection fleet and the regular aerial inspection flights, some "resourceful" captains resort to various kinds of tricks. First they cover the vessel's name with fenders and then with a net, but sometimes they simply paint over it. Of course, the poachers don't wish to enter into a conversation with the fish protection inspectors.

"Our" violator is no exception. The side number is covered with a fishing net. Vladimir Burkanov attempts to spot some kind of details that characterize the given vessel.

Volodya is young, but he has a lot of experience. Last year alone the state inspector had 180 hours of flying time in all. And not a single flight is like another. Each one increases vigilance and skill.

In spite of the gale, the trawler slices confidently through the waves and swiftly leaves the restricted area. But the violator's coordinates were fixed by the navigators.

I hear the command to proceed farther to the south. We're detecting two more violators. These are fishing vessels of the Sea of Okhotsk mintai expedition. We determine their location in accordance with the bearing of a ground station.

The Yak-40 is making a special trip. It ascended into the air especially for protecting the sea. From what is it necessary to protect it? It distresses me to acknowledge it, but often it's from the very same keepers of the seas. Therefore, having made just a brief landing for refueling, our aircraft also flies for 10 hours over the sea. And the radio alert messages go to "Kamchatrybvod."

"Petropavlovsk-Kamchatskiy. Seven vessels spotted working with beam trawls. Inspector Burkanov."

And special fish protection vessels hurry to the indicated area in accordance with these radio messages. We see one of them on the return route. The fish protection colleagues exchange information. Now Burkanov is calm. The violators will be punished in accordance with all standing regulations.

And the Yak-40 maintains a heading to Petropavlovsk. And below us already in the windows are the Kamchatka ground with the sugar summits of volcanos, geysers, fantastically broken lines of hills, and numerous snaking rivers.

We're landing. The regular flight has ended. A routine working day of the state inspector of fish protection has come to an end.

9889
CSO: 1829/335

BRIEFS

FISHING FLEET UPGRADED--The Far East fishing fleet has been replenished. The freezer vessel "Tayezhnyy Bereg," which can take 9,000 tons of fish on board, has departed on its first voyage. The high level of mechanization allows the refrigerator ship to handle products in a rapid manner. [TASS] [Text] [Moscow VODNYY TRANSPORT in Russian 31 May 84 p 1] 9889

TRAWLER DEPARTS FOR OCEAN--Nilolayevsk on the Amur (Khabarovsk Kray). The standard seiner and trawler "Baley" underwent trials at the berths of the shipbuilding plant in Nikolayevsk on the Amur, and not in the sea. Yesterday it assumed operations ahead of schedule. The plant's collective is persistently searching for ways to further improve the efficiency and quality of labor. [Text] [Moscow SEL'SKAYA ZHIZN' in Russian 9 Jun 84 p 1] 9889

CSO: 1829/335

RIVER FLEET MINISTRY ACTS TO SOLVE OSETROVO PORT PROBLEMS

Moscow RECHNOY TRANSPORT in Russian No 4, Apr 84 p 12

[Article by P. Olenev, department chief of the Main Freight Administration, Ministry of the River Fleet: "There Are Problems and They Must Be Resolved"]

[Text] The Osetrovo port is one of the most important transshipment centers for delivering national economic freight to the northern regions of Irkutsk Oblast and the Yakutsk ASSR. It is a large, modern, mechanized river transport enterprise, capable of handling over 18,000 tons of general freight through its berths every day. The port is undergoing constant development. Just during the years of the 10th Five-Year Plan and the first three years of the current five-year plan, 51.9 million rubles in capital investments were allocated for its development; the central and western freight areas were rebuilt; construction was completed on the third section of the port and the fourth section is under construction; and a total of 51,200 square meters of living space has been built, in addition to other projects for social, cultural, and everyday use. New warehouse areas are being built and more railroad spur tracks are being added.

The USSR State Committee for Material and Technical Supply called for 1,850,000 tons of freight to be shipped through the Osetrovo port in 1983.

The port's collective worked out organizational and technical measures and introduced new technological processes in order to meet this goal successfully. Paired claws are used for the transshipment of all-purpose containers; claw cranes with automatic release are used for loading crates in wire slings; and contemporary automatic materials handling equipment is used to unload packaged and loose freight from closed railcars. An increase in the size of the pallets has made it possible to used new crates weighing up to 5 tons; extensive use has been made of the PSK-4500 wire sling containers, special areas for putting crates together, and claws with automatic loading. All-metal all-purpose pallets with a carrying capacity of 20 tons have been used in loading operations. Introduction of these pallets has brought about significant improvements in the utilization of the available cranes and warehousing services. The "Valmet" automatic container loaders have been put into use at freight-handling sections to move containers with a 20-ton carrying capacity.

The port's collective has prepared successfully for the 1983 shipping season. Repairs on port equipment and freight-handling machinery were completed on

time. Before the shipping season opened, 670,000 tons of different kinds of freight were brought in by rail and stored in the warehouses; the original plan called for 650,000 of freight to be delivered. This made it possible for the Lena United Shipping Company to ship 1,870,000 tons of freight from Osetrovo which means that it exceeded its plan quota by 20,000 tons. All the freight designated for shipment to points on the Yana, Khatanga, Indigirka, Olenek, Anabar, and Kolyma rivers has been delivered. The plan for container shipments has been met. In 1983, 1200 more railcars were unloaded than in 1982.

In spite of all this, there are still many unresolved problems in the operation of the Osetrovo transshipment center. For example, in connection with inadequate development of shunting tracks at the Lena station, it is impossible to accommodate the required number of railcars for sorting and delivery to the unloading docks, without which it is impossible to provide continuous operation of the port. In recent years, as a result of a flow of freight for the Baykal-Amur Mainline and local construction and supply organizations, the volume of freight shipped through the port has almost doubled; but the capacity of the station's shunting tracks has not grown at a sufficient rate, and they cannot handle the incoming flow of railcars. Therefore, the administration of the East Siberian Railroad needs to eliminate this disparity.

In accordance with the system in effect, enterprises engaged in dispatching freight are obliged to ship to the Far North consumer goods, various instruments, small electrical articles, spare parts for motor vehicles, and wine and vodka products in soft packing material in all-purpose containers; other types of products and cement are to be shipped in crates, on pallets, and in special containers. Every year between 15 March and 15 September the Ministry of Railways is supposed to allocate containers to the freight dispatchers that are to be used in railcar freight shipments with through combined rail and river connections, with transshipment at the Osetrovo port. In spite of the fact that over 10 years have passed since the new shipping system was implemented, a significant amount of freight arrives at the Osetrovo port in unpackaged form. The port workers have had to use their own resources to package the cargo or load it into containers. Every year 35-40 port workers are taken from unloading railcars to perform these jobs. Over the last 3 years, 50,000-60,000 tons of packaged and loose cargo has been loaded into containers. Only about 2 percent of the loose cargo arrives at the port in packaged form. Special brigades have to pack the loose cargo onto pallets or in wire slings. Every year over 2.5 million rubles are spent on these operations, with no return on the expenditures.

The situation with containerized freight arriving by rail is extremely unsatisfactory. In 1983 the plan called for 145,500 containers to be delivered to the port, but only 103,000 arrived, or 70 percent of the plan.

Planning agencies of ministries and departments are not doing enough to reduce the number of freight dispatcher enterprises. For example, in the third quarter of 1983, 21 grain products administrations shipped grain cargo and flour through the Osetrovo port; 18 enterprises shipped vegetables and fruit; and 107 enterprises under different ministries and departments shipped food and industrial goods. With such a large number of freight dispatchers, it is

impossible to establish control over the priority of shipments from enterprises and to organize through shipments.

As a result of the lack of control, the dispatchers, as a rule, ship freight during the third 10-day period of the month, which leads to an extremely irregular flow of freight into the Osetrovo port, and every year up to 1500 railcars accumulate at the Bratsk railway branch.

The port and the Lena railway station suffer great losses in their capacity as a result of uncoordinated operations.

Cooperation among single shifts of port and railroad station workers has not been organized and socialist competition among them has not been set up. A system of accounting for the railcars that are being processed not based on railcars' numbers has not been organized. The center's coordinating council does practically nothing.

In December 1981 the collegium of the Ministry of the River Fleet reviewed the results of the work done by the Lena United Shipping Company and assigned the managers of the shipping company and the port the task of working out and implementing measures aimed at fulfilling the 1984 plan for freight shipments and the quota for delivering national economic cargo to the Yakutsk ASSR and the northern regions of Irkutsk Oblast, which is set at 1,950,000 tons; at eliminating the shortcomings outlined by administrative organs in 1983; activating the work of the coordinating council at the Osetrovo Transshipment Center, by orienting its activities toward improving the shift and daily plans for processing transport equipment, regulating the work of information services, and joint resolution of problems that arise; establishing strict control over and organizing constant accounting of the fulfillment of plan quotas for containerized and packaged freight shipments; developing measures to ensure the safety of the cargo; and putting into operation the complex now under construction which is part of the fourth section of the port, with a total of 200 meters of moorage space.

The collegium demanded that the ministry's Main Freight Administration use operations plans to stipulate the volume of freight for transshipment in accordance with the set quota, and to work continuously with ministries and dispatcher departments to deliver the planned amount of freight for transshipment.

9967
CSO: 1829/301

BETTER CARGO TRANSFER EQUIPMENT FOR RIVER PORTS NEEDED

Moscow RECHNOY TRANSPORT in Russian No 4, Apr 84 pp 34-37

[Article by V. Kiselev and V. Strakhov, of the Water Transport Economics and Exploitation Central Scientific Research Institute; and G. Sokolov, of Leningrad State River Transport Design Institute: "Prospects in Port Mechanization"]

[Text] The Water Transport Economics and Exploitation Central Scientific Research Institute, together with Leningrad State River Transport Design Institute and other institutes under the Ministry of the River Fleet, have studied ways of intensifying transfer processes at river ports; speeding up the processing of vessels, railcars, and trucks; and increasing labor productivity among port workers. On the basis of a study of the conditions and technical and economic prerequisites for utilizing new means of mechanization, rational models and type sizes have been developed and directions have been outlined for work on creating and introducing highly productive transfer equipment, and the equipment's efficiency has been evaluated.

The research and development work that has been done showed that the fundamental way to resolve problems of scientific and technical progress at river ports is to move to a qualitatively new and higher level of organization, technology, and mechanization of transfer operations, based on the creation and widespread use of specialized, highly productive transfer equipment and complexes with increased processing capabilities (unit capacity). The necessary conditions and technical and economic prerequisites for this exist today--the structure and volume of the freight turnover, the corresponding fleet, and experience gained in creating and utilizing transfer equipment.

The dominant trend up until now has been to increase the processing capacity of ports by increasing the quantity of transfer equipment and to make some increases in individual parameters, but today this method does not meet current demands and does not provide the necessary intensity for processing vessels in ports and the required efficiency of materials handling.

Portal and floating cranes with hoisting capacities of 5, 10, and 16 tons are still the basic transfer equipment at ports. The productivity of crane equipment has increased primarily as a result of increasing the hoisting capacity. This parameter, however, has reached its maximum limit for river port cranes. Further increases in their operating speed are not possible

either, because of limitations resulting from the physiological possibilities of the personnel operating the equipment. The long free length of cable suspensions and the length of the cranes's rotating working movements practically eliminate the possibility of automation.

The existing models for mechanizing the transfer of loose cargo not only do not meet long-range demands, but even contemporary demands in terms of increasing the intensity of processing railcars and vessels, and in terms of raising labor productivity. It is well known that the application of these models does not eliminate spillage of cargo onto crane and railway tracks, damage to railcars and trucks caused by crane clamshells, the need for repeated transfer of cargo with a 2- and 3-row arrangement of the cranes, or an extra-long mooring frontage with a single-row arrangement.

The number of cranes at river ports is rising constantly and has now reached 2-3 units per 100 meters of mooring frontage. The processing capacity of the moorings rises only insignificantly, which is explained primarily by a shortage of workers.

In connection with the fact that in the future the shortage of manpower will be felt even more severely, the possibilities for increasing the volume of cargo being processed by increasing the fleet of transfer equipment will be extremely limited. All these circumstances dictate the need to move to a higher level of organization and mechanization of transfer equipment by introducing automated equipment with higher unit capacities.

This change can be made by creating and installing at existing moorages highly productive means of mechanization to replace and supplement portal cranes (without changing the lay-out of the ports) or by converting to specialized transfer complexes for loose cargo that make use of containers and continuous transport and cyclical continuous transport machinery with automated control systems (this applies to construction of new ports or general reconstruction of existing ones).

Two groups of transfer equipment are of interest for future unloading of loose cargo from ships: combined cyclical continuous transport using clamshell-bunker transfer equipment; and continuous transport using bucket-chain conveyor or rotary conveyor transfer equipment.

The clamshell-bunker loaders, like portal cranes, are all-purpose and can be used to transfer various types of cargo and to process different types and sizes of ships with varying water levels in the moorages. They are also considerably more productive than cranes, since they can operate at higher speeds and at a shorter distance than that required by the clamshell crane. They can be automated and can operate in conjunction with a system of continuous transport warehouse equipment. This type of materials handling equipment is being utilized extensively in foreign ports and is the primary equipment at moorages used for loose cargo.

The basic directions for further improvement in the clamshell-bunker equipment are: the use of cable traction for the cargo cart; increasing the speed of the working movements (the hoisting speed to 180 m/min and the movement of the

carts to 240 m/min); increasing the hoisting capacity (to 60-80 tons); increasing productivity (to 4500 tons/hr), and raising the level of automation right up to total automation of the entire cycle.

An analysis showed that the clamshell-bunker transfer equipment can be utilized at domestic river ports. The transfer equipment with a hoisting capacity of 16 tons and a productivity of 800 tons/hr (the GBP-800) can be used to replace cordon portal cranes at existing ports; it can operate under any of the following situations: loading from ship to piles, from pile to railcar, and from ship to railcar. So that it can be used as a replacement, this loader should form a pile that has the same width as the pile formed when a ship is unloaded by crane. With this aim, there are plans to use a revolving dump conveyor. Since the receiving bunker of the loader designed for installation at moorages with railroad tracks on the cordon should be located above the railcars, the railcars can be loaded by means of a shuttle conveyor, which makes it possible to compensate to a significant degree for the effect of the difference in capacity between the railcar and the ship, and also to load at least four open railcars from a single position. This makes it possible to load directly, without having to shift the position of the railcars.

However, in connection with the fact that no more than 20 percent of the loose cargo is being transferred by means of this method, the primary method being used is the pile-to-railcar method. When railcars are loaded with the help of a railcar loading conveyor, no cargo is spilled. The model for mechanization using the GBP-800 transfer equipment is depicted in figure 1.

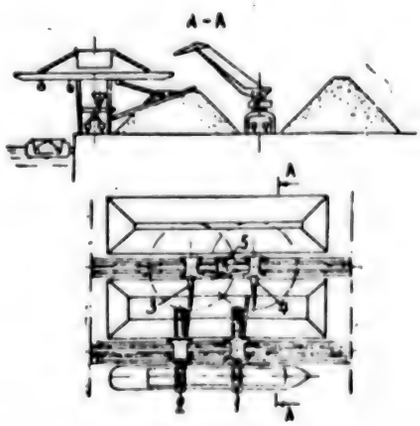

Figure 1. Model of transferring loose cargo at a moorage with the GPB-800 clamshell-bunker transfer equipment (1, 2) on the cordon; with portal cranes (3, 4), and a VZBU railcar loading machine (5).

The GPB-1500 transfer equipment has a hoisting capacity of 32 tons and a productivity of 1500 tons/hr and is designed for specialized cargo transfer complexes at new ports that are equipped with a warehouse conveyor system. The technological variants for using this equipment are: ship-to-bunker-to-conveyor (the basic variant); ship-to-bunker-to-pile and pile-to-bunker-to-conveyor (auxiliary variants). In certain cases the loader can be used to perform materials handling operations with the pile-to-ship variant. Taking into account the high speeds of the operating movements and the heavy weight of the clamshell filled with cargo, special attention should be given to lowering the clamshell gently into the cargo hold so as to avoid damage to the ship. The unloading machine should have an automatic programmed control system. The operator's functions are reduced to observation and making corrections in the operating program.

The clamshell-bunker transfer machines with a dual-console design and a cable system for moving the carts correspond to contemporary trends in the development of this type of machinery.

A floating bucket-chain conveyor transfer machine with an output of 1500 tons/hr (the NKP-1500), based on a design by the Leningrad State River Transport Design Institute and the Gorkiy Central Design Bureau, is nearing completion. It is to be used to unload sand and gravel materials from ships on an unequipped bank at the Gorkiy Water Transport Center (unloading during the course of the navigation season will take place at several points).

With the help of its dumping conveyor, the NKP-1500 transfer equipment can form a relatively small pile of materials. To continue operations after the initial pile has been formed, the transfer machine must either be moved to a new position, or rear mechanization equipment must be available. Frequent shifts of the equipment are not always possible and they waste work time. Therefore, it is expedient to create a special mobile conveyor that can build piles (the ShU-1500), whose receiving conveyor can be attached to the dumping conveyor on the transfer machine. By moving along the arc of a circle, this type of mobile conveyor can form an arc-shaped pile weighing up to 400,000 tons.

Taking into account that the NKP-1500 will be produced in '984, immediate measures must be taken to develop and manufacture a pile-forming conveyor with the same level of productivity. The results of tests and experimental operation of the bucket-chain conveyor transfer machine will answer the question of the expediency of using not only floating equipment, but also this type of shoreline transfer equipment at river ports. Their inherent shortcomings must be taken into account, since unlike the clamshell-bunker transfer machines, the bucket-chain conveyor equipment cannot be used when there are large fluctuations in water level in the moorage, and with cargo that includes large pieces. In light of the fact that they are being produced as specialized equipment for one type of loose cargo, it does not seem possible that they can be used effectively for transferring other types of freight. Furthermore, one needs to take into account that it is not possible to unload ships with holds using the bucket-chain conveyor apparatus, and that the manufacture and repair of this equipment is very labor-intensive.

In the future, unloading open railcars using the clamshells of portal cranes should be discontinued because of the considerable damage to the cars and the large amount of manual labor required to clean out the cars. Two unloading methods can be recommended: one involves using a railcar-dumper (with a consistent flow of cargo that exceeds 2 million tons per year); the other involves elevator railcar unloading machinery. The railcar dumpers will be used at specialized transshipment complexes equipped with a system of permanent conveyors. The railcar unloading machines can be used at moorages not equipped with permanent conveyors.

The Central Planning and Design Bureau of the Ministry of the River Fleet is now finishing work on a plan for an elevator railcar unloading machine with a capacity of 400 tons/hr. It will have an apparatus for cleaning out the remains of cargo from railcars and two sharply inclined dumping conveyors that are needed to build a pile of cargo.

(1) Наименование	(2) Основные характеристики				Назначение (8)
	производительность (3)	(4) Вылет, м		Колея, м (7)	
		прием (5)	отвал (6)		
Плавучий норийно-конвейерный перегружатель НКП-1500 (9)	1500 t/hr		45	—	Выгрузка МСМ из судов на необорудованный берег (25)
Вагоноразгрузочная машина ВРМ (10)	400 t/hr		28	10,5	Выгрузка угля из полувагонов в штабель (26)
Конвейерная погрузочная машина КМП-2500 (11)	2500 t/hr		25	15,3	Погрузка навалочных грузов с конвейера в суда (27)
Грейферно-бункерный перегружатель ГБП-800 (12)	800 t/hr	17,3	32	10,5	Выгрузка навалочных грузов из судов в действующих портах по вариантам судно — штабель и судно — вагон (28)
Грейферно-бункерный перегружатель с автоматическим управлением ГБП-1500 (13)	1500 t/hr	16,5	16,5	15,3	Выгрузка навалочных грузов из судов на причалы специализированных перегрузочных комплексов (29)
Загрузочная установка-штабелеукладчик ЗУШУ-900 (14)	900 t/hr	22 28	32	10,5	(30) Загрузка полувагонов, образование штабеля при работе совместно с ГБП-800 и роторным экскаватором
Штабелеукладчик ШУ-1500 (15)	1500 t/hr	22—28	32	10,5	Образование штабеля при работе совместно с НКП-1500, ГБП-1500 и роторным экскаватором (31)
Автозагрузочная бункерная установка АЗБУ-500 (16)	500 m^3/hr	29	—	4,5	Загрузка автомашин МСМ при совместной работе с роторными погрузчиками или портовыми кранами грузоподъемностью 10—16 т (32)
Вагоноразгрузочная бункерная установка ВЗБУ-900 (17)	900 m^3/hr	—	—	10,5	Загрузка полувагонов при работе совместно с портальными кранами грузоподъемностью 10—16 т (33)
Роторно-конвейерная складская машина РКСМ-1500 (18)	1500/1250 t/hr	35—40	35—40	8 (24)	Подача навалочного груза со складского конвейера в штабель, отпуск груза из штабеля на конвейер на спец. перегрузочных комплексах (34)
Роторный погрузчик (экскаватор) РП-320 (19)	200/320 m^3/hr	6,2	12	гусеничный ход (24)	Загрузка навалочных грузов в автомашины из штабеля. Подача груза из штабеля на конвейер АЗБУ и ЗУШУ (35)
То же РП-500 (20)	320/500 m^3/hr	9,3	20	гусеничный ход (24)	Подача груза из штабеля на конвейер АЗБУ и ЗУШУ (36)
То же РП-1150 (21)	690/1150 m^3/hr	12,1	20	гусеничный ход	Подача груза из штабеля на приемный конвейер (37)
Передвижная конвейерная погрузочная машина ПКПМ-1200 (22)	1200 t/hr	16	25	10,5	Погрузка навалочных грузов в суда из штабеля при совместной работе с роторным погрузчиком (экскаватором) РП-1150 (38)
Плавучая конвейерная погрузочная машина КПМпл-2000 (23)	2000 t/hr	23	25		Погрузка МСМ в суда на складах-накопителях при совместной работе с роторным экскаватором, ШУ-1500 и НКП-1500 (39)

Key:

1. Type of equipment
2. Basic characteristics
3. Productivity
4. Overhang, m
5. Receiving
6. Dumping
7. Track, m
8. Designated use
9. NKP-1500 floating bucket-chain conveyor transfer machine

10. VRM railcar unloader
11. KMP-2500 conveyor loading machine
12. GBP-800 clamshell-bunker transfer equipment
13. GPB-1500 clamshell-bunker transfer equipment with automatic control
14. ZUShU-900 loader and pile layer
15. ShU-1500 piler layer
16. AZBU-500 automatic loading bunker apparatus
17. VZBU-900 railcar unloading bunker apparatus
18. RKSM-1500 rotary conveyor warehouse machine
19. RP-320 rotary loader (excavator)
20. RP-500 rotary loader (excavator)
21. RP-1150 rotary loader (excavator)
22. PKPM-1200 mobile conveyor loading machine
23. KPMpl-2000 floating conveyor loading machine
24. Caterpillar drive
25. Unloads mineral and construction materials from ships to unequipped shore
26. Unloads coal from open railcars to pile
27. Loads loose cargo from conveyor to ship
28. Unloads loose cargo from ships at existing ports, either from ship to pile or from ship to railcar
29. Unloads loose cargo from ships to moorages with specialized transshipment complexes
30. Loads open railcars and builds piles, used together with the GBP-800 and rotary excavator
31. Builds piles when used with the NKP-1500, GBP-1500, and rotary excavator
32. Loads trucks with mineral construction materials, used with rotary loaders or portal cranes with a hoisting capacity of 10-16 tons
33. Loads open railcars, used with portal cranes with a hoisting capacity of 10-16 tons
34. Moves loose cargo from warehouse conveyor to pile, delivers cargo from pile to conveyor at specialized transshipment complexes
35. Loads loose cargo from pile into trucks. Delivers cargo from pile onto AZBU and ZUShU conveyor
36. Moves cargo from pile onto AZBU and ZUShU conveyor
37. Moves cargo from pile onto receiving conveyor
38. Loads loose cargo from pile onto ships, used with RP-1150 rotary loader (excavator)
39. Loads mineral construction materials onto ships at warehouse-storage areas, used with rotary excavator, ShU-1500, and NKP-1500.

It is efficient to use loading machines for loading ships with loose cargo at specialized complexes with a system of conveyors when there is a large flow of cargo. Studies show that it is expedient to load ships using one machine with a productivity of 2500 tons/hr, which receives cargo from two main conveyors. This ensures proper loading of the ships. When two loading machines are used, which is the arrangement in the design of the Kambarka port, the loading operations are controlled by two operators working independently, which makes it difficult to monitor adherence to specifications and instructions for loading and can lead to damage to the ships being loaded.

The overhang of a conveyor on a loading machine should provide loading of two lines of cargo without being broken up.

At moorages with average and small freight turnover, as in the past portal cranes with a hoisting capacity of 10-16 tons will be used in the near future

for loading loose cargo onto ships. Later in the future, however, they should be replaced by mobile conveyor machines that work together with continuous transport warehouse loaders. At moorages with warehouse and storage areas for mineral construction materials, ships can be loaded by a floating conveyor machine with a productivity of 1200-2000 tons/hr, that operates in conjunction with a pile layer and a rotary loader (excavator).

The problem of providing ports with equipment for mechanizing warehousing operations should be resolved by creating or acquiring two different types of machines: those designed for joint operation with portal cranes (for a fairly long transitional period); and those that replace cranes and bulldozers. Both types of machines can be used at the same time, depending on the composition of the basic transshipment equipment.

At specialized complexes for transfer of loose cargo whose port warehouses are equipped with a conveyor system, two types of warehousing machines can be used successfully: all-purpose machines with two-way action (the so-called stacker-reclaimer machines or all-purpose loading and unloading machines); and machines with one-way action, one of which feeds cargo into the warehouse (stackers, dumpers, or pile layers), while the other moves cargo from the warehouse (reclaimers). The second type of machine is used when the warehouse contains several different kinds of cargo, whose arrival and dispatch happen to coincide, or when the intensity of the dispatch and delivery of cargo differs significantly.

Rotary-type devices are used primarily as the cargo scooping element of continuous transport warehouse machines (reclaimers and stacker-reclaimers). These are the most all-purpose, reliable, and simple scooping devices and they can be used successfully to scoop up practically any material. Other types of cargo scooping devices are meant to be used only in specific cases.

For port warehouses with a conveyor system, we can recommend the use of rotary conveyor warehouse machines with two-way action and productivity of 1500/1250 tons/hr; dumping conveyor belts with a productivity of 1500 tons/hr; and type SR-130 and SR_{SS}-280 rotary loaders (excavators) with a productivity of 500 m^3/hr and 1150 m^3/hr, respectively (made in the GDR). Railcars and trucks should be loaded at warehouses of this type at centralized loading areas using a weight-measured loading system and a system for calculating the amount of cargo already given out.

For storing loose cargo at port warehouses that are not equipped with permanent conveyors, use of the ShU-1500 pile layer with a productivity of 1500 tons/hr is recommended; it is designed for operation with a floating bucket-chain conveyor transfer apparatus (figure 2); also recommended is the ZUShU-900 loading apparatus-pile layer with a productivity of 900 tons/hr, used with the GBP-800 clamshell-bunker transfer equipment.

The pile layer is a self-propelled gantry with a rotating section that has a receiving and dumping conveyor. The ZUShU-900 loader differs from a pile layer in terms of the productivity of the receiving and dumping conveyor and the presence of an additional shuttle conveyor for loading railcars. It is intended for use in storing cargo (when the dumping conveyor is used) and for

loading open railcars (when the railcar loading conveyor is used). The cargo is fed onto the dumping conveyor or the railcar loading conveyor from a receiving conveyor, which connects with the dumping conveyor of the clamshell-bunker transfer equipment; cargo from the ships's hold is fed into the rear storage pile or into a railcar without additional transfer.

Loose cargo from warehouses not equipped with permanent conveyors can be transferred by means of the SR_S-65 rotary loader (excavator) when loading trucks; the SR_S-130 rotary loader when railcars are being loaded (together with a pile loading apparatus); and the SR_S-280 rotary loader when cargo is being fed onto a conveyor loading device and then into the hold of a ship.

Studies have shown that loading mineral construction materials onto trucks at specialized moorages should be done by means of the AZBU-500 self-loading bunker machines, with a self-propelled gantry that has a transfer bunker (funnel) that can be used to load trucks. The cargo can be fed into the bunker by a rotary excavator by means of an inclined, fully rotating transfer conveyor, joined by a hinge to the bunker, or to the clamshells of portal cranes with a hoisting capacity of 10 or 16 tons. With the latter arrangement the transfer conveyor is dismantled.

For specialized moorages not equipped with a permanent conveyor system, the VZBU-900 bunker apparatus for loading railcars should be developed and used; it has a self-propelled gantry with a double receiving bunker, and two shuttle conveyors for loading railcars, and has a capacity of 900 tons/hr. This type of apparatus can be installed on rear crane tracks between portal cranes. Cargo can be fed into its bunker by means of clamshells on 2 portal cranes with a hoisting capacity of 10 or 16 tons. This results in a high level of productivity in loading railcars.

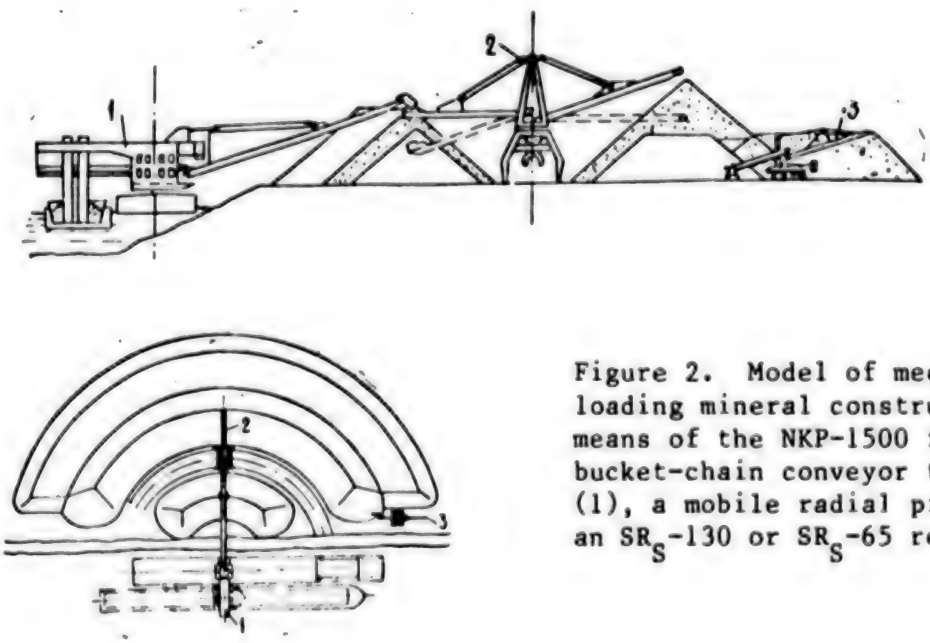

Figure 2. Model of mechanization of loading mineral construction materials by means of the NKP-1500 floating bucket-chain conveyor transfer equipment (1), a mobile radial pile layer (2); and an SR_S-130 or SR_S-65 rotary excavator (3).

Loading machinery should be equipped with instruments and devices for measuring each load for railcars and trucks, and for calculating the amount of cargo that has been given out. The machinery may also be equipped with a remote control system so they can be controlled from posts for operating the basic transfer equipment.

Pre-planning studies showed that the model for mechanization using the recommended transfer machinery and devices is significantly more efficient than the equipment now being used at river ports. From the list of future transfer equipment described above, the three most complicated machines should be developed and produced by enterprises of the USSR Ministry of Heavy and Transport Machine Building: the clamshell-bunker transfer machines with a productivity of 800 and 1500 tons/hr should be produced by the Hoisting and Transport Equipment Plant imeni S. M. Kirov; the RKSM-1500/1250 rotary conveyor warehouse machine should be produced by the South Ural Machine Building Plant (in Orsk). The rotary loaders (excavators) with capacities of 320, 500, and 1150 m^3/hr can be purchased in the GDR until domestic industry puts them into production. Series production of railcar-loading elevator machines, after an experimental model has been tested, should be assigned to one of the plants under the Ministry of Heavy and Transport Machine Building, since these machines are needed for various sectors of the national economy. All the rest of the equipment should be developed by planning organizations under the Ministry of the River Fleet and manufactured at its enterprises. Construction of the most complex machine--the floating bucket-chain conveyor transfer apparatus with a capacity of 1500 tons/hr--will be completed in 1984. The demand for each type of machinery and equipment needed for equipping river ports up to the year 2000 will reach several dozen units.

The table presents a list of the types of transfer machinery and equipment recommended for development and introduction.

Today ports must pay the entire cost of advance models of this type of machinery, and therefore in economic terms they have no incentive for acquiring the equipment. Furthermore, it is often the case that ports are forced to suffer losses as a result of reasons beyond their control. In our opinion, it is necessary to change the existing situation and to set up a system under which ports will receive advance and experimental models at a cost equal to the limit price for a series machine, and the difference in cost will be covered by the scientific and technical development fund, which will be increased accordingly from the sector's operating expenditures.

Expanding the production of port equipment makes it necessary to specialize a group of industrial enterprises and equip them for producing transfer machinery, equipment, and devices.

Measures should also be taken for organizational strengthening of subdivisions of the Water Transport Economics and Exploitation Central Scientific Research Institute and the Leningrad State River Transport Design Institute, that are studying problems in the technology and mechanization of port operations and the planning and design of transfer equipment.

Finally, it is absolutely necessary to develop and confirm a comprehensive program for 1986-1990 and up to the year 2000 for developing and installing highly productive automatic cargo transfer machinery at ports of the Ministry of the River Fleet and to ensure its implementation.

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CSO: 1829/301

INCREASING EFFICIENCY AND DEVELOPMENT OF TRANSPORTATION

Moscow EKONOMIKA I MATEMATICHESKIYE METODY in Russian Vol 20, No 2, Mar-Apr 84 (manuscript received 15 Nov 83) pp 197-211

[Article by Doctor of Economic Sciences Professor Veniamin Naumovich Livshits, chief of a laboratory of the All-Union Scientific Research Institute of Systems Research (Moscow): "The Problems of the Increase of the Efficiency of the Operation and the Development of Transportation"]

[Text] 1. Introduction

Transportation is a major sector of the national economy, which is playing an important role in the accomplishment of the tasks posed by the 26th CPSU Congress of the changeover of the USSR economy to the primarily intensive means of development, the further increase of the well-being of the USSR population, the rationalization of economic operations and the effective development of new economic regions of the country and its natural resources.

However, the operation of transport, especially rail transport, in recent years has been faced with problems which are serious and significant in scale ["Materialy XXVI s"yezda KPSS" [Materials of the 26th CPSU Congress], Moscow, Politizdat, 1981, p 39]. As Comrade Yu. V. Andropov noted at the November (1982) CPSU Central Committee Plenum, "the Politburo is concerned about the state of affairs in transportation. The Ministry of Railways as before is not meeting the needs of the national economy for the transportation of fuel, lumber, other freight.... The indicators of the operation of railroads, unfortunately, from year to year have been worsening, in spite of the substantial assistance which the government is giving the Ministry of Railways. The amount of capital investments for this ministry has increased by 43 percent as compared with 1975, while the fleet of mail-line diesel and electric locomotives has increased by 23 percent. The CPSU Central Committee and the government have adopted a number of decisions on the improvement of the social conditions of railroad workers and the improvement of the economic mechanism in transportation. However, for the present there is not the proper return from the steps taken."[Yu. V. Andropov, "Izbrannyye rechi i stat'i" [Selected Speeches and Articles], Moscow, Politizdat, 1983, pp 213-214].

Definite positive changes were noted in 1983. According to a report of the USSR Central Statistical Administration during the first half of 1983 "the operation of transport improved somewhat. The freight turnover of all types of

transport came to 3.7 trillion ton-kilometers and had increased as against the first half of last year by 5.2 percent. The passenger turnover came to 451 billion passenger-kilometers and had increased by 3.1 percent. The plan assignments on these indicators were exceeded" [1]. The plan on transportation for all of 1983 was also fulfilled ahead of time.

The development of this trend and the further improvement of the operation of transport require the increase of the scientific soundness of the plans of its activity and the improvement of the organization and management of transport as a unified whole. Back in 1920 the Eighth All-Russian Congress of Soviets specified that "the congress attaches great importance to the elaboration of a unified operating transportation plan, which encompasses both railways and waterways and has been carefully coordinated with all the departments which serve the economic needs of the country" [2, pp 151-152].

Such a systems approach is especially important today, when the complexity of the structure and the scale of the transportation complex of the country have increased sharply. The decree of the CPSU Central Committee and the USSR Council of Ministers "On the Improvement of the Planning and Organization of the Transportation of National Economic Freight and the Strengthening of the Influence of the Economic Mechanism on the Increase of the Efficiency of the Operation of Enterprises and Organizations of Transportation," which was adopted in 1982 and extends to transportation the provisions of the decree of the CPSU Central Committee and the USSR Council of Ministers of 12 July 1979 [4], also directs attention precisely toward this.

The problems of the increase of the efficiency of the operation and the development of transportation are complicated and manysided. Among them first of all one should point out the improvement of the quality of service of clientele and the decrease of the expenditures of the national economy on the operation and development of transportation.

For these purposes it is necessary to increase the balance of the plans of the development of transportation and the base sectors of physical production and the nonproduction sphere, to create reserves in transportation, to ensure the efficient breakdown of transportation among its types and their efficient coordinated development within the unified transportation system, to improve the management of freight and passenger transportation and to speed up the introduction of the achievements of scientific and technical progress--new equipment, technology, advanced methods of the organization of the operation of transportation. This can be achieved only by the overall optimization of operation. Such a strategy is envisaged by the decisions of the 26th CPSU Congress, which specified the need for the elaboration of a long-term comprehensive program of the development of transportation.

Important steps on the realization of this program are being taken in the 1980's, when a scientific, technical, production and organizational potential, which is capable of ensuring the accomplishment of the task of the complete and timely meeting of the needs of the national economy and the population for transportation, should be created. As is indicated in the Basic Directions of USSR Economic and Social Development for 1981-1985 and the Period to 1990, which were adopted by the 26th party congress, for these purposes it is necessary:

"to improve the organization of the transportation process and its management;

"to increase the level of use and the reliability of the operation of transportation equipment;

"to improve the coordination of the operation of all types of transport and their interaction with other sectors of the national economy, to introduce a more advanced technology of transportation in mixed service;

"to ensure the further improvement of the planning of the operation of transportation, to eliminate cross-hauls, excessively long-distant and other inefficient transportation of freight, to decrease the specific transportation costs and the expenditures of resources on the transportation of freight and passengers;

"to strengthen the material and technical base of transportation, to speed up the introduction of new equipment, advanced technology and automated control systems, to increase the level of the complete mechanization of loading and unloading operations and repair work;

"to improve the structure of the rolling stock and the fleet, having ensured their more extensive specialization;

"to enlarge the sphere of use of new vehicles for the transportation of freight in the northern regions of the country, as well as for urban and suburban passenger service;

"to expedite the development of the container transportation system, to expand the transportation of packaged freight by the pallet-container method and to increase the network of specialized stations which are fitted with equipment for the handling of containers and pallets;

"to improve significantly the service of passengers on all types of transport;

"to increase traffic safety and to ensure the decrease of the harmful effect of transportation on the environment;

"to improve the organization of transportation in international service" ["Materialy XXVI s"yezda KPSS," pp 170-171].

The implementation of the long-term comprehensive program will require significant expenditures of the most important national economic resources, and therefore the problem of the increase of the socioeconomic efficiency of their use in transportation is a key problem. During the coming period it will be necessary to eliminate the lag in the development of transportation, which appeared especially distinctly in the 1970's. It seems that one should group among the basic causes not only the fact that previously inadequate capital investments were allocated to transportation (this was indicated in the Accountability Report of the CPSU Central Committee to the 25th party congress ["Materialy XXV s"yezda KPSS" [Materials of the 25th CPSU Congress], Moscow, Politizdat, 1976, p 44], but also the fact that there are a large number of unsolved scientific problems of the evaluation of the efficiency of the operation and

the development of transportation, which are connected with its specific nature. Due to the failure to take it into account the opinion formed that capital investments in the development of transportation are ineffective and their payback time is significantly longer than the standard time. Such an appraisal, which was due to the imperfection of the method of determining the efficiency, had a direct influence on the investment processes in transportation, hindering its development. The main attention in this article is also directed to the procedural questions of the evaluation of the efficiency of the use of resources in transportation.

2. The Specific Nature of Transportation

Transportation as a sector of the national economy has many peculiarities, which have a direct influence on the efficiency of the use of resources and the methods of its evaluation. Let us list the most important of these peculiarities.

1. Transportation is an infrastructural sector and a relatively small proportion in the gross product and the national income and a significant share in the consumption of production resources (fixed capital, capital investments, manpower resources--see Table 1) are accordingly characteristic of it.

2. Transportation closely interacts with practically all the sectors of the national economy and is a decisive factor when solving many economic, social, ecological and other problems. The operation of transportation objects is of a service nature, that is, here a new physical and material product is not created. This peculiarity of the activity of transportation at times affects the amount of investments which are allocated for its development.

3. In the process of producing the transportation product (in contrast to the industrial product) the objects of labor (the freight and passengers being transported) should not undergo any physical changes. What has been said, of course, does not mean that the objects of labor in transportation do not change in the production process any of their properties. Thus, when carrying out the conveyance of raw materials and finished products, transportation increases their value.

4. It is impossible to store and accumulate the transportation product, the processes of its production and consumption are indivisible, since the very conveyance of freight and passengers is the product of transportation. The unstorable nature of the transportation product requires the existence of relatively large reserves of capacity of transportation objects (especially in the area of permanent facilities).

5. In the current expenditures on transportation the wage and amortization deductions take up a quite large proportion (50 percent and more), which is explained by the absence in transportation of its own raw materials. The proportion of intersector outlays in the total amount of material expenditures does not exceed 3-4 percent (in chemistry, metallurgy--more than 40 percent) [7]. At the same time transportation is a major consumer of fuel and energy resources--more than 15 percent of them are used for its own needs.

Table 1

The Proportion of the Infrastructure and Its Sectors in the National Economy, percent [5, 6]

Infrastructure of Physical Production and Its Sectors	Years			
	1950	1960	1970	1980
In the gross national product				
Total	7.0	7.6	7.6	7.9
Including:				
transportation and communications*	3.5	4.0	4.1	4.4
trade, public dining, material and technical supply, procurement	3.5	3.6	3.5	3.5
In the fixed production capital				
Total	31.3	29.0	27.5	26.2
Including:				
transportation and communications	25.6	23.7	21.9	20.8
trade, public dining, material and technical supply, procurement	5.7	5.3	5.6	5.4
In the number of people employed in physical production				
Total	10.2	13.2	16.4	19.3
Including:				
transportation and communications	4.9	6.7	7.3	8.5
trade, public dining, material and technical supply, procurement	5.3	6.5	9.1	10.8
In the production capital investments				
Total	21.4	19.2	17.6	19.6
Including:				
transportation and communications	18.7	14.4	13.7	16.2
trade, public dining, material and technical supply, procurement	2.7	4.8	3.9	3.4

*The proportion of transportation and communications in the produced national income is somewhat greater, but still small: in 1965--5.9 percent, in 1970--5.6 percent, in 1975--6.3 percent, in 1980--5.8 percent.

6. Transportation is a very capital-intensive and capital-consuming sector of the national economy (the corresponding data are cited in Table 2). The capital-output ratio of transportation and communications with respect to the national income comes to 7.2-9.1 rubles/ruble (accordingly with respect to the gross product 4.5-5.1 rubles/ruble) and significantly exceeds (by three- to fivefold) the capital-output ratio with respect to the fixed production capital as a whole and, especially, in industry.

7. In transportation there are lengthy periods of the designing, development and operation of fixed capital.

8. In transportation, as a rule, the phase-by-phase (stage-by-stage) increase of the capacities of its permanent facilities is carried out. Here, when some stage has been fulfilled (for example, a new road in the transportation network has been put into operation), reserves of the traffic capacity, which are assimilated not immediately, but gradually, over several years, are created.

Table 2

The Capital-Output Ratio of the National Economy and Its Sectors*

Indicators of capital-output ratio	Years			
	1965	1970	1975	1980
As a whole for the national economy				
with respect to all fixed capital	3.106; 1.43 1.67; 1.669	2.966; 1.336 1.619; 1.62	3.457; 1.456 1.56; 1.54	3.804; 1.627 1.518; 1.518
with respect to fixed production capital	1.86; 0.857 1.0; 1.0	1.832; 0.825 1.0; 1.0	2.216; 0.933 1.0; 1.0	2.506; 1.072 1.0; 1.0
Including by sectors				
industry	1.678; 0.631 0.902; 0.736	1.719; 0.623 0.938; 0.755	2.014; 0.69 0.908; 0.74	2.36; 0.81 0.942; 0.756
agriculture	1.766; 1.081 0.949; 1.261	1.68; 1.021 0.917; 1.238	2.715; 1.365 1.225; 1.463	3.449; 1.585 1.376; 1.479
transportation and communications	7.217; 4.536 3.88; 5.293	7.178; 4.553 3.918; 5.519	7.4; 4.659 3.339; 4.994	9.087; 5.085 2.626; 4.743
construction	0.67; 0.3 0.36; 0.35	0.733; 0.325 0.4; 0.394	0.847; 0.382 0.382; 0.409	1.141; 0.528 0.455; 0.493
trade, procurement, material and technical supply and other sectors of physical production	0.98; 0.826 0.527; 0.964	0.963; 0.829 0.526; 1.005	1.015; 0.877 0.548; 0.94	0.81; 0.729 0.323; 0.68

*In the upper line respectively the capital-output ratio in rubles per ruble of national income and per ruble of the gross national product are indicated, while in the lower line the ratios of these indicators to the capital-output ratio, which was calculated with respect to the fixed production capital as a whole for the national economy, are indicated. Calculated according to [5].

9. The operation of transportation objects has the property of persistence: they are capable of operating for some time "inertially," by means of overloads and to the detriment of the quality of the product, while nevertheless preserving the appearance of the meeting of the needs.

10. Characteristic of transportation is the variable utilization in time of its objects with a rising trend by years and with significant seasonal, monthly and daily fluctuations, which are due to the nonuniformity of traffic.

11. The objects of transportation, as a rule, are of the spatial-network type and limited territorial interchangeability in case of the production of the transportation product is peculiar to them.

12. In the transportation system there are a large number of interacting components, which is responsible for the appearance of a significant emergent effect and the possibility of accomplishing the posed goals by various means.

13. There is no unified system of management of transportation as a whole, including main-line transportation, common and noncommon carrier: the sharp departmental separation of management occurs, which leads to a significant increase of the transportation costs outside the sphere of circulation.

14. For the transportation system as a whole and its individual components it is impossible to predict unequivocally the conditions of their operation and many technical and economic parameters of their construction, functioning and development. The indeterminancy is due both to the internal properties of the transportation system and to the incompleteness and inaccuracy of the information, which are inevitable in case of calculations for the future.

15. Transportation realizes the bulk of domestic economic relations and is actively involved in the accomplishment of the international division of national labor.

16. The basic impact from the functioning and development of transportation is frequently manifested outside it in the indicators of the work of other sectors, that is, its results are found first of all outside the sector itself, being dissolved in the economic indicators of the base sectors which are served by it. Therefore the indicator of the role of transportation, which has been measured by means of the rates for transportation, is understated by several times as against the systems evaluation, which was obtained during special studies.*

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*Such an evaluation does not include, as a rule, even all the national economic expenditures which are connected with the activity of the infrastructure. Thus, the transportation costs in the national economy, according to the estimates made at the Central Scientific Research Institute of the Ministry of Railways by A. A. Pugachev, in 1977 came to about 86.7 billion rubles, of them only approximately one-third are expenditures on transportation, in accordance with which the operating costs are recorded by transportation ministries.

3. On the Enhancement of the Role of Transportation at the Present Stage

In the future the development of social production in the USSR will take place under conditions which differ in principle from the preceding stages of the creation of the material and technical base of communism. Among the most important new phenomena, the trends of which emerged already during the preceding period, one should note:

the substantial increase of the shortage of fuel, energy and other mineral resources; the shift of the raw material (first of all fuel and energy) base to the eastern and northern regions of the country; the appreciable increase of the expenditures on the extraction of raw materials and their delivery to consumers;

the decline of the growth of manpower resources owing to the onset of the demographic "echo" of World War II and for several other reasons. Practically the entire increase of production should be accomplished without an increase of the number of people employed in the sphere of physical production;

the appreciable increase of the volumes of production, which is accompanied by its complication and the increase of the intensity of the interaction (first of all in the area of transportation and economic relations) of the various subdivisions of the economy;

the further extension of the social division of labor on the sectorial and territorial levels; the intensification of the processes of the specialization, cooperation and combination of production;

the change of the nature of reproduction: during the 11th Five-Year Plan for the first time the planned growth rate of the national income leads (and substantially) the growth rate of capital investments. According to [10, pp 18-19] the growth of capital investments during 1981-1985 will come to 12-15 percent as against 29 percent during 1975-1980, accordingly the increase of the proportion of the national income, which is used for consumption and accumulation, is planned at the level of 18-20 percent. Therefore the strategy of the intensification and the increase of the efficiency of social production on the basis of the all-out introduction of the achievements of scientific and technical progress (first of all resource-saving processing methods, equipment and methods of the organization of production) and the creation of the conditions for the quickest and thorough realization of these achievements is becoming the basic strategy;

the estimated cost of the creation of the fixed capital of the infrastructure increased appreciably. This is connected, among other things, also with the increase of the proportion of construction in the regions of pioneering development, as well as with the "making more strict" of the standard demands on technical parameters as a result of the increase of the load of infrastructural, especially transportation objects. Thus, the average annual increase of the estimated cost of new railway lines during the 10th Five-Year Plan is 7.1 percent, second tracks--6.1 percent, electrification--2.65 percent [11]. The average freight traffic of railroads in 1980 exceeded 24 million ton-kilometers as against 3.7 million ton-kilometers in the United States, pipeline

transportation in the transfer of petroleum--respectively 10 million ton-kilometers and 3.8 million ton-kilometers, petroleum product pipelines--2.75 million ton-kilometers and 2 million ton-kilometers [5];

the increase of the role of foreign economic relations and their intensification; the volume of foreign trade of the USSR during 1970-1982 increased from 22.1 billion rubles to 119 billion rubles [5].

All the listed conditions are making additional demands on transportation, and therefore its reliable and efficient operation determines to a significantly greater degree than before the success of the accomplishment of the tasks of the intensification of social production, which were posed by the 26th CPSU Congress.

Accordingly the changed conditions also require a different strategy of the development of transportation (incidentally, as well as of the entire production infrastructure as a whole).

In principle it is possible to distinguish three basic possible strategies [12]:

1. the leading development of the infrastructure, when it precedes the appearance of the bulk of the objects of the base sectors, which are served by it;

2. the synchronous development of the infrastructure, when both the infrastructural and the base objects are created practically simultaneously;

3. the delayed development of the infrastructure.

Each of these strategies has its own advantages and drawbacks--the later making of investments facilitates the carrying out of investment processes, but leads to additional (at times significant) national economic losses.

During the first years of Soviet power the leading type of development was characteristic of our country and considerable resources were allocated to the sectors of the infrastructure (first of all transportation and power engineering). Thus, in the plan of the State Commission for the Electrification of Russia measures with the amount of capital investments were planned: electrification--1.2 billion rubles in gold; the processing industry--5 billion rubles; the extractive industry--3 billion rubles; transportation--8 billion rubles (46.5 percent of the total amount of investments in power engineering, industry and transportation) [13]. Subsequently (especially in the 1960's and 1970's) the proportion of the investments in the infrastructure decreases noticeably, the type of strategy also changes. Accordingly the proportion of the infrastructure in the fixed production capital decreases monotonically, the number of people employed in this sphere of physical production increases sharply (see Table 1).

At present owing to the lag of development of the infrastructure (including transportation) the annual national economic losses come to tens of billions of rubles [14]. With reference to transportation these losses, which are economic in their nature, include three structural components:

1. the direct losses of the already produced product in the process of its transportation (about 10 percent of the produced glass, 15 percent of the produced brick, 2.5 percent of the coal, up to 4 percent of the ore, 3-5 percent of the cement and so on are lost annually during transportation) [15-16];

2. the increase of the current production outlays on the output of products as a result of the incomplete, untimely or inadequately efficient transportation service of the clientele and the operation of transportation itself;

3. the missed advantage, that is, the failure to obtain the potential additional national economic impact (the greater output of products in the base sectors, the increase of their quality, the decrease of the production cost and others) due to the restrictions on the operation of transportation.

For the purpose of the minimization of the losses and the improvement of the transportation service of the national economy it is necessary:

1. to change over to the strategy of the leading or, at least, the synchronous development of transportation with respect to the base sectors of the national economy;

2. to introduce in transport construction industrial methods of the creation of fixed capital;

3. to use goal program methods extensively when planning the development of transportation as a whole and its subdivisions;

4. to improve the methods of the organization and management of the operation of transportation (especially motor transport, the proportion of which in the total transportation costs of the national economy comes to approximately two-thirds [9]).

In the end all this should be aimed at the increase of the national economic efficiency of the operation and development of transportation (the most important directions with respect to motor transport are indicated in a decree of the CPSU Central Committee and the USSR Council of Ministers [17]).

4. The Principles of the Evaluation of the Socioeconomic Efficiency of the Use of Resources in Transportation

By the socioeconomic efficiency of various economic measures, which are being implemented in transportation, there is understood the comprehensive characterization of the end national economic results of their implementation with allowance made for both the economic and the social, demographic, ecological and other factors, which are significant from the point of view of the goals of socialist social production.

In spite of the significant differences of individual types of such measures and the specific nature of transportation and the conditions of its functioning at the present stage, which was noted in Sections 2 and 3, when evaluating the socioeconomic efficiency of the use of resources in it it is advisable to be guided by several general methodological provisions (or principles), the most important of which are the following [18-19].

1. Systems Nature. A systems analysis of all the basic consequences of the decisions being made in transportation with the tracing of both the direct and inverse relations brought about by them between the immediate objects of such decisions and the other subdivisions of the national economy is necessary. Here one should take into account the scale and the place of the corresponding measures in the multilevel system of the planning and management of social production, the degree of their influence on the components of the economic structure, which interact with them (which depend, in particular, on the amounts of resources being used), the existence and intensity of the intra-transportation, extratransportation and so-called synergistic effects and so forth.

The synergistic effects, which arise as a consequence of the irreducibility of the properties and characteristics of the transportation system as a whole to the properties and characteristics of subsystems which make it up, also lead to the formation of emergent effects (effects of integrity). They can change substantially the ideas about efficiency, and as the complexity of the objects of these decisions increase, the influence of the effects of integrity usually increases. One should note the specific nature of the appearance of synergistic effects in transportation--frequently during the implementation of quite efficient measures the indicators of the activity of transportation initially worsen and only then begin to improve drastically. Such was the case, for example, with the introduction of electric and diesel locomotive traction, the simultaneous existence of which along with steam engines caused additional difficulties. A similar situation arose in case of the use of the automatic coupler instead of the screw draft gear and others.

2. Comprehensiveness. When evaluating the efficiency of measures in transportation it is necessary to take into account the all-round consequences of their implementation: both the influence of the measures in question on the economic indicators of the transportation objects themselves and the objects of the base sectors, which are connected with them, and such results of a social, ecological and other nature, which are attributable to these measures and which allow only in part an economic evaluation. For example, when choosing the structure and parameters of rolling stock one should introduce the economic evaluation of transportation fatigue and the time of passengers, which is freed by means of the shortening of the wait for transportation or travel [19-20]. When optimizing the plans of the development of road systems it is necessary to take into account the dependence of the rates of traffic accidents on the measures being planned and so on.

3. The National Economic Approach. The efficiency of the measures in transportation should be evaluated from the point of view of their influence on the end national economic results and of their maximum possible conformity to the goals of the socioeconomic system as a whole. However, the present real economic mechanism in transportation, the prevailing rates and the systems of evaluation and stimulation inadequately direct attention to the achievement of the end results. As a consequence of this the implementation of measures, which are effective from the standpoint of the economy as a whole (or their versions, which are optimum from the same point of view), is not always possible on the basis of the immediate interest of the corresponding transportation objects. In this connection with respect to the measures, the

implementation of which is planned in the immediate future, one has to take into account their practical feasibility on the basis of such interest under the conditions of the present economic mechanism. As to the measures, the implementation of which presumes the functioning of the objects in the more distant future, the elaboration and implementation of suggestions on the improvement of the economic mechanism, including on the increase of the degree of conformity of the criteria of the evaluation of the activity of transportation objects to the national economic goals of their operation, are necessary at the same time as the measures on the improvement of equipment and technology.

4. The Special-Purpose Nature of Calculations. The calculations of efficiency have a certain specific nature depending on the specific purposes for which they were made, on the stage at which they are carried out, and so forth. One should distinguish the calculations which are made in transportation for the purposes of: the comparison of the versions of plan decisions and the choice of specific measures for implementation; the evaluation of the planned efficiency of the measures being outlined and the actual efficiency of the implemented measures.

The amount of necessary information on problems of optimizating the operation of transportation is sometimes less, while the demands on its accuracy are not as strict as in case of the subsequent analysis of efficiency. Whereas in the latter case, as a rule, it is necessary to determine and compare all the essential components of the expenditures and results, in the calculations of optimization it is sufficient to confine onself to the consideration of only those of them, on which the optimum decision depends. The components, which are invariable for all the alternatives, can be excluded from the optimization calculations as not having an influence on the choice of the optimum decisions, moreover, this applies both to the simplest situations of the complete ordering of the alternatives according to a scalar criterion and to more complicated situations (which are typical of large transportation systems) of their ranking in accordance with many goals within the problems of vector optimization. Here it seems desirable always, when this it possible, to form in a meaningful way synthetic special-purpose indicators (in the form of a vector of small dimension, and ideally a unidimensional vector), which gives a generalized value of the socioeconomic efficiency of the use of all types of resources in accordance with the alternatives being compared.

The question of the exclusion from optimization calculations of the components, which are invariable for all alternatives, is especially important in case of the consideration of transportation in the problems of the optimum location and development of production. Here it is sufficient to limit oneself to the inclusion of only the additional transportation expenditures. This makes it possible to facilitate significantly the process of both the preparation of information and the solution of sectorial problems owing to the much greater stability of the specific additional transportation expenditures and, consequently, the greater legitimacy of their use within the linear optimization models of the problems of the development and location of production. This important and so far for some reason controversial problem is analyzed in detail in [21].

5. The Consideration of the Limited nature of Resources. The amount of all renewable and nonrenewable resources, which society has at each moment of time (or within any fixed segment of time), is objectively limited. Therefore one

should proceed from the fact that with respect to each of the measures in question or their versions the use of any of the resources is advisable only on the condition that it yield no less an effective impact than in case of the use of this resource in the corresponding amount somewhere in another place (within transportation or outside it) in case of the rejection of the implementation of this measure. The indicated initial assumption should in principle always serve as the methodological basis of the quantitative evaluation during each year of all the types of expenditures, which are connected with the implementation of the planned economic measures, in case of comparisons of the versions of the corresponding decisions. It is necessary to include in these expenditures the valuations of the consumed and used:

a. material resources (the full valuation for resources of one-time use; the amortization component for resources of long-term use);

b. natural resources (which is rental in content);

c. productive capital and capital investments (which is rental in form);

d. manpower resources;

e. information resources (the expenditures connected with the purchase of licenses and so forth).

In case of the involvement of transportation in the measures, which are connected with foreign trade operations, it is necessary to take into account the limitedness of the corresponding currency fund, the standards and procedures of its efficient use [22].

6. Coordination. The alternatives of economic decisions in transportation, which are being evaluated, and the methods of their evaluation should be reduced to a comparable form in accordance with a number of attributes, including in accordance with:

a. the feasibility of the alternatives, that is, in accordance with the possibility of the backing of each of them with resources of all the required types within the limits, which the national economy can allocate for the goals in question;

b. the completeness of the coverage of the expenditures and results, that is, the consideration in the process of optimization of all their elements, which are essential for the correct making of the evaluation of each of the alternatives; it is especially important here to take into account the extratransportation components, the amount of which comes to 30-40 percent and more;*

c. the absence of the double counting of some expenditures and results or others (this requirement is often violated in practical calculations);

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* In a number of practical tasks (the evaluation of the efficiency of transportation in the development of the Western Siberian Petroleum- and Gas-Bearing Province and others) the extratransportation component of the impact exceeded significantly (by three- to fivefold) the intratransportation component [23].

d. the standard base being used; the degree of reliability of the socioeconomic characteristics and parameters being used according to the alternatives; the specific methods and levels of the evaluation of the resources being consumed;

e. the degree of conformity of the indicators and criteria of optimization, which are being used, to the content of the problem and the initial premises which are used when solving it;

f. the existence in the used indicators of efficiency and criteria of optimization of the above-mentioned properties of a systems nature, comprehensiveness and others.

The principle in question also presumes the fulfillment of a number of conditions of conformity in the system of planning and the economic mechanism (the coordination of current and long-range plans, the prevailing rates and the shortage of resources, the rates and the plans of the development of transportation in the system of social production and others).

7. Less than optimum Alternatives. The calculation of the efficiency of economic measures in transportation and the comparative evaluation of the corresponding versions of these measures should be made on the basis of the preliminary optimization of the endogenous parameters and the modes of the functioning of transportation objects. In other words, the versions must be compared in case of fixed external limitations and the choice of the relatively best internal conditions for each version. Thus, when evaluating the comparative efficiency of freight transportation by diesel locomotive and electric traction, it is necessary to determine in advance the optimum speed for them (which, generally speaking, can be different).

When analyzing the social consequences of some decisions or others and their economic significance, it is necessary to examine the entire range of possible degrees of compensation and the corresponding measures and to choose the most economical one of them, by including the expenditures required for this in the total of the expenditures according to the specific version of the decision as a whole. When evaluating the planned efficiency of the development of transportation the component of the extratransportation effect should be determined as a result of the optimization calculations, which are connected with the comparison of the amounts of losses from the damage of products, the worsening of social indicators and so on with the expenditures in the sectors on the elimination or the decrease of these undesirable consequences.

8. The Consideration of the Degree of Structurization of the Problems. Under the conditions of well-structured problems, when a large number of alternatives and all their socioeconomic characteristics and preferences are clearly defined and allow reduction, the evaluation of efficiency can be made according to a scalar criterion, in which all the essential results and expenditures are synthesized (as a rule, in value terms). In general, when with respect to the alternatives both the expenditures and the results can change, the achievement of the maximum national economic impact is such a criterion in the problems of optimization. Here, if such standards indicators, for example, as prices and rates depend on the measures being implemented, including the volumes of output being produced, services and so forth, the calculations of efficiency are made

with allowance for their corresponding changes. If these standards in practice are not elastic (at least within the interval of their fluctuations in the system, which occur as a result of the decision in question), the criterion of the maximum national economic impact is modified into the criterion of the maximum national economic profit, in case of the calculation of which the standard fee for all the production resources being used is taken into account.

The methods of multipurpose optimization (in a number of instances with the participation of experts) should be used for poorly structured problems, interactive procedures of the evaluation of efficiency by means of the essentially informal man-machine process of the making of decisions, as a rule, should be used for unstructured problems [24]. Precisely such an approach is the basis for the automated control system for planning calculations, which has been developed in recent years, within the automated control systems of individual types of transportation and the transportation complex as a whole [25].

9. Dynamism. When evaluating the efficiency of measures in transportation it is necessary to take thoroughly into account the different aspects of the time factor: the change both of the volumes and structure of transportation, the expenditures and results in transportation and outside it and of the values of the standard indicators, the existence of lags of different types, the economic nonequivalence of the expenditures and results of different times and so on. If information is available on the essential long-range changes of the prices for the resources being used (for example, diesel fuel, electric power and others) and the evaluations of the attainable results, the calculations should be made not in constant, but in predicted prices and evaluations. The values, which correspond to the version in question of the development of transportation and are integral for the accounting period, of the differences of the results and expenditures, which have been reduced to a comparable form with the reflection of the factor of the nonequivalence of their values at different times, act as the criteria of efficiency (optimality) when taking the time factor into account. Such reduction should be made to a base moment of time, which is uniform for all the alternatives, by the multiplication of the values of the expenditures and results by the corresponding coefficients. In the problems of optimization the base moment of time is established on the basis of only the considerations of the convenience of the calculations as applied to the conditions of the specific problem, since the observance of the requirement of the unity of this moment for all the versions ensures identical results of the choice from among them of the optimum one. In several other problems of the evaluation of efficiency the choice of the base moment of time is essential and should be regulated by the corresponding instructional and procedural documents.

10. Manageability. In the problems of the optimization of the development of transportation the determination of the most advantageous versions of economic measures should be carried out as the search for the optimum management of the functioning and development of the system in question during the coming period of time. This requirement has a number of aspects.

The Extreme Nature of Management. The past does not lend itself to optimization, and therefore there is no need to include in the calculations the already made expenditures and the results. With respect to the consideration of the

embodied resources which are being freed (productive capital and others) two situations occur. In the first the resources can be used in the national economy outside the immediate object of the measure in question with one efficiency or another; in the second it is impossible to use the resources efficiently and they are liable to liquidation. In the former case the amounts of the forthcoming expenditures should in case of optimization be taken into account with the deduction of the positive national economic evaluation of the resources being freed (but, of course, with the inclusion of the expenses which are connected with such freeing); in the latter, the expenses, which are due to the liquidation of the resources being freed, but not their depreciated (incompletely amortized) value, are included in the expenditures.*

Stage Nature. The compilation of the plans of the development of transportation, the construction of new transportation objects and the modernization and renovation of operating ones is of a discrete nature. When evaluating the efficiency of the planned versions of economic measures within the processes of suboptimization it is necessary to bear in mind not only the search for the most advantageous technical decisions, but also the determination of the best characteristics of the process of their realization in time (the start and finish of the construction of a railroad, the transition from a one-track block to two-track blocks and a continuous second track, the introduction of electrification). Thus, in the general dynamic formulation each version of the planning decisions can be a kind of "splice" in time of several quasistatic parts of it, the parameters and modes of functioning of which and the sequence of the transition from one stage to another should also be chosen in the most advantageous manner.

The Incompleteness of Information. The basic socioeconomic indicators, which determine the amount and dynamics of the expenditures and results by versions of the planning and design decisions in transportation (especially taking into account the lengthy periods of the building and functioning of its objects) usually cannot be precisely known, but are given within the framework of the objective trends of the development of processes with some uncertainty which increases in time. Therefore the criteria of optimization, which are acceptable in determinate cases (the minimum expenditures, the maximum effect and others), should be used in modified form in conformity with the principles of the theory of statistical decision.

The Complete Utilization of Useful Information. In case of optimization under the conditions of the incompleteness of information in many cases it is possible to obtain new data, to decrease the degree of uncertainty and so on at the cost of additional expenditures of financial, manpower and other resources. However, it is not always advisable to realize these possibilities: it is important to put to use only the useful information, the anticipated expenditures on the gathering and use of which are noticeably less than the probable impact from its use. At the same time it is necessary to derive and introduce into the process of the comparison of the planned and design versions all the useful

*Unfortunately, in a number of methods (including those in effect in individual types of transport) the incorrect recommendation to add the incompletely amortized value (minus the amounts of sales) to the capital investments is given.

information, which it is possible to have without substantial additional expenditures, including the information which pertains to not the basic characteristics of the measures being analyzed. Although this process is not always trivial, the receipt of new useful information can lead to the reassessment of the alternatives.

The cited set of principles does not lay claim to completeness--the specific socioeconomic tasks, which are connected with the operation of transportation, are too diverse, but they encompass important methodological aspects of the problems of optimization, which it is necessary to take into account. The methods of the realization of the indicated principles in the specific methods of the making of planning and design calculations and the evaluation of efficiency are also no less important--here (especially when examining not individual transportation objects, but their elaborate complexes) the corresponding systems of models of the functioning and development of transportation, which include simulation and optimization models and so on, should find extensive use.

For the most part all these principles are based on the experience of planning and design calculations in transportation, which has undergone many years of checking. The experience and the principles of the evaluation of efficiency, which are based on it, were also incorporated in the general transportation method of the evaluation of the effectiveness of capital investments, which was issued in 1982 and was elaborated under the aegis of the Scientific Council of the USSR Academy of Sciences for the Complex Problem of the Unified Transportation System [19].

It should be noted that the calculations of efficiency are the most important component of the overall process of the planning of the development of the transportation complex. It is possible to distinguish two basic approaches, when the transportation complex is examined: 1) within the framework of the unified iterative scheme of the optimization of the entire national economy in inseparable connection with the development of other sectors; 2) as a relatively autonomous dynamic complex system which develops in accordance with the objective laws which are inherent in such systems. A fundamental description of both approaches is contained in [26].

5. Models of the Evaluation of the Efficiency of the Development of Transportation

The model of the calculation of the integral effect from the functioning and development of transportation [27] can be presented in conformity with the principles set forth in Section 4 by

$$\Theta_T^{\text{об}} = \sum_{t=t_0}^{t=T} \left[\sum_{i,k} (Q_t^{ik} \text{Ц}_t^{ik} + H_t^i + S_t^i - K_t - C_t + \lambda_t) \right] \times (1+E)^{t_0-t} + \Phi_T^{\text{ост}} (1+E)^{t_0-T}, \qquad (1)$$

where t_0 is the initial year of the accounting period, T is the final year of the accounting period; Q_t^{ik} is the amount of activity of type k of transportation during year t in sphere i of the national economy; Ц_t^{ik} is the rates for transportation service of type k during year t in sphere i; $H_t{}^i$ is the valuation during year t of the associated economic impacts from the development of

transportation, which are obtainable in sphere i and have not found the appropriate reflection in the values of Q_t^{ik} and $Ц_t^{ik}$; K_t is the one-time expenditures on the development of transportation during year t; C_t is the change in connection with the development of transportation of the net current outlays on its functioning during year t; S_t^i is the valuation during year t of the associated extraeconomic (social, ecological and others) results, which are obtainable both in transportation and outside it and did not find appropriate reflection in the values of Q_t^{ik}, $Ц_t^{ik}$, K_t and C_t; λ_t is the depreciated value of the fixed capital of transportation, which is being excluded from operation during year t (if it cannot be used in the national economy, its liquid balance is regarded as λ_t); $\Phi_T^{ост}$ is the depreciated value of the created capital at the end of the accounting period; E is the standard of the adjustment of nonsimultaneous expenditures.

The determination of the comparative efficiency (that is, the choice of several possible ones of the most advantageous version of the development and functioning of transportation) can be made according to the formula

$$\max_j Э_{Tj}^{абс},$$

where j is the index of the version.

Accordingly the effect Δ_{j_0,j_1} of the transition from version j_1 to version j_2 is equal to

$$\Delta_{j_2,j_1} = Э_{Tj_2}^{абс} - Э_{Tj_1}^{абс}.$$

In the majority of practical cases the effect of the activity of transportation (that is, the amounts, periods and quality of service) is usually fixed, that is, the values of Q_t^{ik} and $Ц_t^{ik}$ are given. Then criterion (1) is transformed into

$$\min_j \sum_{t=t_0}^{t=T} \left[(K_{t_j} + C_{t_j} - \lambda_{t_j}) - \sum_i (H_{t_j}^i + S_{t_j}^i) \right] (1+E)^{t_0-t} - \Phi_{T_j}^{ост} (1+E)^{t_0-T},$$

that is, the version, in case of which all the necessary activity is ensured in case of the minimum total adjusted expenditures during the accounting period with the deduction from them of the amounts of the obtainable associated national economic impacts (the economic impacts and the social impacts which have been compared with them, the ecological impacts and others), is considered the best.

The indicated formulas of the calculation of the absolute and comparative effect of the development of the infrastructure are legitimate, if all the essential results allow an obvious economic evaluation. This is equal to real processes, when it is a question of "small-scale" measures in the area of transportation, that is, of individual objects and their relatively small complexes. In general the cited economic evaluations should be supplemented by other indicators, that is, the transition to multipurpose optimization and other, not completely formalized, man-machine procedures of the evaluation of efficiency is necessary.

Of course, the problem of increasing the level of operation of transportation does not reduce only to the examined procedural questions. The implementation of the chosen effective means, the improvement of the economic mechanism of the activity of transportation and the introduction in it of the achievements of scientific and technical progress, which requires an independent study, are no less important. The decrees of the CPSU Central Committee and the USSR Council of Ministers [3, 28] create the basis of the practical accomplishment of these tasks of the further substantial increase of the efficiency of transportation.

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IMPROVING TRANSPORTATION'S ECONOMIC MECHANISM

Moscow EKONOMIKA I MATEMATICHESKIYE METODY in Russian Vol 20, No 2, Mar-Apr 84 (manuscript received 4 May 84) pp 212-222

[Article by Candidate of Economic Sciences Anatoliy Leybovich Braslavskiy, senior scientific associate of the Institute of Complex Transportation Problems attached to the USSR State Planning Committee, and Yevgeniy Ivanovich Kochetov, junior scientific associate of the Institute of Complex Transportation Problems attached to the USSR State Planning Committee (Moscow): "The Problems and Means of Improving the Economic Mechanism of Transportation"]

[Text] In a speech at the June (1983) CPSU Central Committee Plenum Comrade Yu. V. Andropov defined the Party Program under present conditions as a program "of the systematic and comprehensive improvement of mature socialism and, hence, of further progress toward communism" [KOMMUNIST, No 9, 1983, p 6]. Prime importance here is attached to the improvement of production relations, which finds its specific expression first of all in the reorganization of the economic mechanism. The study of the experience already gained in accomplishing this task in the area of both the achievements and the failures and the identification of their causes is a necessary condition so that science could suggest to practice the solution of problems which conform to "the principles and conditions of mature socialism" [Ibid., p 12].

The enterprises of transportation, first of all motor transport, for many years have been used as a kind of testing ground for the practical checking of new suggestions on the improvement of the economic mechanism, which is of not only sectorial, but also national economic importance.

In a number of large production units of motor transport and railroads the components of the economic mechanism, which are now undergoing development in connection with the implementation of the decrees of the CPSU Central Committee and the USSR Council of Ministers "On Improving Planning and Strengthening the Influence of the Economic Mechanism on Increasing Production Efficiency and Work Quality" of 12 July 1979 [1] and "On the Improvement of the Planning and Organization of the Transportation of National Economic Freight and the Strengthening of the Influence of the Economic Mechanism on the Increase of the Efficiency of the Operation of Enterprises and Organizations of Transportation" of

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For the purpose of posing the question.

28 October 1982 [2], have undergone checking. The goal of the article is to identify on the basis of the analysis of the results of the experiments the problems which it is necessary to solve in the process of the further improvement of the economic mechanism of transportation.

On the Essence and Structure of the Economic Mechanism

The direction of the study of the functioning of the economic mechanism to a significant degree is determined by the understanding of its essence and by the notion of its structure. The view of it as the mechanism of the control of the process of the implementation of plans is most prevalent. According to this conception, the formation (improvement) of the economic mechanism of the cost accounting subdivision reduces mainly to the choice (change) of the indicators being approved, for the fulfillment of which administrative and material liability is established; the structural "blocks" correspond to the functions of management--planning, organization and stimulation. The main role is assigned to planning; the purpose of organization and stimulation lies in the assurance of the fulfillment of the plan.

But given such a segmentation of the economic mechanism its integral parts "are split." Thus, for example, some components of the system of the formation of the funds for the remuneration of the labor of workers are usually examined when determining the list of the indicators of the plan, which are being approved, others are examined among the economic standards, still others are examined in connection with economic stimulation. As a result not the specific functions of the components of the economic mechanism and the relations between them, but their managerial status: what indicators should be approved and by whom, is brought to the forefront. Abstract and unproductive disputes, like the still unfinished discussion about "the main indicator" of transportation, arise owing to this.

The reality of management functions is unquestionable. The fact that, for example, the mechanism of the formation of the funds for the remuneration of labor is under the jurisdiction of various organs of economic management, is also a reality. For this reason the analysis of the economic mechanism from the point of view of the structure of the functions in question has a definite basis behind it. But the relations of management are the relations between managers and the managed, yet they are not basic. Apparently, for this reason the "management" conception only "takes into account" the existence of other interests, except the national interest, as a condition of the realization of the latter.

The regulating role of the national interest, as experience shows, can be realized to the extent of the coordination of the entire system of interests. Therefore, starting with the initial introduction of cost accounting, the coordination of the national collective and personal economic interests, which are inherent in socialism, was the basic problem of economic reforms. Such coordination far from reduced to the improvement of the forms of the stimulation of the labor of individual workers and collectives. Up to now the strengthening of labor collectives as the subject of economic interests and production relations and the development of the external and internal ties of labor collectives, through which the regulating role of the national interest in case

of the guaranteed nature of the observance of the economic interests of labor collectives and its individual members is realized, are one of the most important tasks.

In our opinion, the economic mechanism, which is examined from the point of view of its essence, is a set of interrelations which ensure the coordinated realization of economic interests of a different degree of community in their interconnection with the present needs. The content of the economic mechanism is revealed through the appearance of a system of ties, first, between economic interests in the form of the distribution of the newly created value (the national income) and, second, between the appropriation of value and the meeting of needs.

When studying the interconnection of the economic mechanism and the plan, it is necessary to distinguish the quantitative parameters of its components--the nomenclature of the plan, the values of the norms of quality (the standards), the norms of the wage, prices, the rates of penalties and so on and the system of interrelations. The former are established and coordinated by the plan (and in this sense it actually represents the core of the economic mechanism), the latter are determined by the socioeconomic system of society and therefore are independent of the content of the plan for one period or another.

The interrelations, which ensure the achievement of specific ties between the economic interests and needs of various subjects, form special mechanisms, the system of which also forms the economic mechanism in the structural respect. The methods of the formation and use of the funds for the remuneration of labor and the meeting of social needs are the nucleus of this mechanism in the cost accounting subdivision. Moreover, the mechanisms of the synchronization of expenditures and the production of output, the reproduction (simple and expanded) of the material and technical base and personnel and several others are a part of it. Each of them is a complex subsystem with a large number of components and ties between them.

The interrelations, which form the economic mechanism, are heterogeneous; among them the economic (directly social or planning and commodity-money), legal, social and organizational interrelations and so on are distinguished. This means that the economic mechanism represents a polystructural formation. Its integral realization presumes the distinction of a base structure, in interconnection with which the structures in the other sections can be understood and revealed most thoroughly. For the stated reasons the structure with respect to the ties of economic interests is regarded by us as the base structure.

In this article we confine ourselves to the analysis of the functioning of the mechanism of the formation and use of the funds for the remuneration of the labor of the collectives of transportation enterprises.

The Fundamental Changes in the Mechanism of the Formation and Use of the Funds for the Remuneration of Labor

During the study of the results of the experiments first of all the changes, which had been made in the mechanisms of the individual funds for the remuneration of labor, and in their interconnection within both individual erterprises and associations of transportation were ascertained.

In the rail and motor types of transportation (as in other sectors of the national economy) the wage fund and the incentive funds are formed by a different procedure subject to the different measures of labor and by means of special sources: the wage fund is formed from the production cost, the incentive funds are formed from the profit. As prior to the experiment, the actual wage fund is formed from individual payments for the performance of individual production operations or functions. The measure of labor determines only the maximum permissible amount of the actual wage fund, in comparison with which a decrease represents a saving, while an increase represents an overspending. There can be no balance with respect to this fund, which is carried over to the following year. Each of the incentive funds--the material incentive fund and the fund for sociocultural measures and housing construction--is formed as a unified whole, which is to be distributed. They constitute remuneration of not so much individual as collective labor in accordance with the end (for the given enterprise) results of production operations. Owing to the specific nature of their formation there can be no overspending with respect to the incentive funds; the portion not used in a given year yields a carryover.

The change attributable to the experiment consists in the fact that in accordance with its conditions the saving of the wage under specific conditions and within set limits is retained by the enterprise. This a practical step in the direction of changing the entire planned (standard) wage fund into an object of cost accounting appropriation, much like the incentive funds.

The correctness of the determination of the saving or overspending of the wage depends on the extent to which the measure of labor reflects the difference in its expenditures on the performance of various types of transportation services. If, for example, the proportion of light-weight freight in the volume of transportation increases, while the adjusted freight turnover is used as the measure of labor, the transportation enterprise can find itself faced with overspending. Therefore the adjusted freight turnover, which performed in motor transport the function of a measure of labor (with respect to the wage fund), with the changeover to the new conditions of management was replaced by the revenues, since the latter, owing to the differentiation of tariffs by kinds of freight, reflect the changes in the structure of transportation. In the departments of the railroads, which conducted the economic experiment, they took the route of the introduction of dissimilar measures of labor with respect to different types of services and operations: with respect to transportation--the adjusted freight turnover; with respect to loading and unloading operations--the number of handled tons of freight; with respect to the capital repair of tracks, building and equipment--the cost of the performed work. The retention of the adjusted freight turnover as a measure of labor for transportation is explained, in our opinion, by the fact that in the departments of the railroads in case of cost accounting, which is oriented toward the administrations of the railroads, the revenues are formed on the basis of not the tariffs, but the rates of return which are common to all types of freight. Under these conditions the changes in the structure of transportation influence the freight turnover and the revenues to an equal degree.

In the area of the regulation of the incentive funds in the departments of railroads no changes occurred: as before, various characteristics perform the function of a measure of labor. At enterprises of motor transport the profit

became the only measure of labor: the planned incentive funds are adjusted only subject to the fulfillment of the plan on this indicator. But owing to the fact that the saving of the wage can be retained by the enterprise, and to the extent to which such a possibility is realized, the profit as a measure of labor proves to be independent of the saving of living labor. The amount of the saving of the wage fund is excluded from the profit which forming the material incentive fund. In this case the profit being distributed does not coincide with either the balance-sheet or accounting profit.

The attempt to introduce the formation of the funds for the remuneration of labor on the basis of stable standards of the wage and deductions from the profit is an essentially new and important feature. By the stability of the standards there is understood their timely establishment (in the five-year plans) and the rejection of adjustment subject to the actually forming results of the work for the purpose of fitting the average wage to the planned level. In the absence of stable standards of the wage not the proportion in the created net product--its contribution to the national income, but the very level of the average wage is in essence guaranteed to the enterprise. Thus, the connection of the latter with labor productivity is actually severed. Stable standards of the wage of collectives is a condition of the long-term coordination of cost accounting and national interests.

Along with the strengthening of the ties within the mechanisms of the formation of the individual funds for the remuneration of labor (with the measure of labor through stable standards) new interdependences between the wage fund and the material incentive fund appeared. Prior to the experiment the saving or overspending of the wage fund caused the opposite change of the profit and the amount of the material incentive fund changed accordingly. Under the new conditions of management a direct tie, which is close to the interflow of the funds for the remuneration of labor, emerged between the funds. The saving of the wage, when the enterprise acquires the right to it, is channeled into the material incentive fund. Its overspending at enterprises of motor transport is covered by means of the reduction of the material incentive fund (the experiment in the departments of the railroads does not envisage such a step). The emergence of a direct tie between the funds for the remuneration of labor is an important step in the direction of their unification and the transformation of the amount of the funds for the remuneration of the labor of the collective into an integral object of cost accounting appropriation. It is necessary to add that, in spite of all the differences in the forms of the formation of the actual funds for the remuneration of labor, their planned amounts "become attached" to a single basis--the planned quota (the planned expenditures of living labor).

As a result of all the changes in the mechanism of the funds for the remuneration of labor the sensitivity of remuneration to the dynamics of the expenditures of living and embodied labor increased substantially. The increase of the sensitivity of the average remuneration to the change of the expenditures of living labor is due to the fact that now the enterprise can retain nearly the entire saving of the wage fund, while in case of overspending it covers at the expense of the material incentive fund up to 100 percent of the additional wage. In case of the interconnection of the funds through the profit the sensitivity is determined by the amount of the standards of the deductions for the

incentive funds. The increase of the sensitivity of the remuneration of labor to the change of material expenditures is explained by the fact that the enterprise has the right to the saving of the wage fund only within the limits of the above-plan profit. If the plan on revenues is fulfilled, the excess of the saving of the wage fund over the above-plan profit implies the existence of additional material expenditures, by the full amount of which the amount of the saving of the wage, which is channeled into the material incentive fund, is reduced. Consequently, in this case the sensitivity of the funds for the remuneration of labor to the change of material expenditures comes to 100 percent. True, such a phenomenon arises only in case of the combination of three circumstances: 1) the existence of a saving on the wage; 2) its exceeding of the above-plan profit; 3) the observance of other conditions, in case of which the use of the saving is possible (of which it is a question below). In the remaining cases the sensitivity as before is determined by the amount of the standards of the deductions from the profit.

Along with the changes in the mechanisms of the funds for the remuneration of labor a system of remuneration, which is common to the associations of motor transport (the republic ministry or the oblast main administration), in essence formed at the enterprises.

This is connected mainly with the formation of specialized funds (the reserve of the wage and the centralized material incentive fund), which are created within the limits of the general standards of the remuneration of labor.* The centralized material incentive fund in part fulfills the functions of the reserve of material incentives, but is mainly intended for the stimulation of the accomplishment of tasks which are of importance for the organization as a whole. The reserves are called upon: to provide temporary assistance to subordinate motor transport enterprises; to support the interrelations of the wage fund and the material incentive fund in case of the use of the latter to cover overspending on the wage; to help see to it that the amounts of the funds for the remuneration of labor of individual enterprises, which are formed according to essentially different standards, would conform to the total amounts of the wage fund and the incentive funds of organizations under the conditions of the uneven fulfillment of the plan assignments on revenues and the profit. Owing to the centralized reserves the cost accounting stability of motor transport enterprises is being strengthened and great material liability for the permitted overspending on the wage is being achieved (in case of the rendering of assistance on a return basis).

The guaranteed making of payments to the budget even by means of the restriction of the formation or use of the funds for the remuneration of labor of motor transport enterprises reflects the national economic ties of large cost accounting organizations.

The formation of more extensive systems of funds for the remuneration of labor with new ties is a process which is progressive, although, as will be shown, not free of certain difficulties.

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*In the departments of the railroads the functions of the reserves and the centralized material incentive fund are performed by their own funds for the remuneration of labor.

The Analysis of the Problems of the Functions of the Economic Mechanism of Transportation

After the ascertainment of the changes in the mechanism of the funds for the remuneration of labor, strictly speaking, the analysis of the problems, which are connected with their functioning, begins. First it is necessary to establish the completeness of the realization of the basic principles of the new economic mechanism. Only then is it possible to pose the question of the influence of the changes in it on the results of production operations.

The study of the mechanisms of the formation and use of the funds for the remuneration of labor, which actually functioned at the inspected enterprises, made it possible to draw the conclusion that it was possible to realize the new features of its organization only in part. It is possible to group with them: in motor transport--the creation of centralized and reserve funds for the remuneration of labor, in rail transport--the use of the saving of the wage in case of an absolute decrease of the number of working people (the latter made it possible to free a certain number of them). For the most part it was not possible to realize the new features of the organization of the mechanisms of the funds for the remuneration of labor, and the former mechanism actually remained (because of several changes, which were indicated above and are not of decisive importance).

Because of various restrictions it proved impossible to retain for motor transport enterprises the saving on the wage. One of them consists in the fact that this saving can be used by the motor transport enterprise (association) only if it was obtained by means of the improvement of a number of indicators (the putting of motor vehicles and trailers on line, the operating speed, the useful life, the utilization ratio of the run and load-carrying capacity). The increase of the average load-carrying capacity of motor vehicles is an important factor of the saving of the wage. But in case of the given structure of shipments according to the lot system the arrival of oversize trucks frequently causes some decrease of the utilization ratio of the load-carrying capacity. The delay with the reorganization of the repair base and the natural difficulties, which arise in case of the repair of new makes of motor vehicles, can decrease the indicators of the putting of motor vehicles on line. The requirement of the improvement of the operating indicators as a condition of the use of the saving of the wage is illegitimate; for the saving was obtained in spite of the worsening of these indicators. If they were higher, the amount of the saving would be greater, so that the use of the saving, which has exceeded the loss from the decrease of the operating indicators, is limited.

Usually they explain the legitimacy of such restrictions by the need to set apart the saving of the wage, which is due to external factors. It is a matter here not simply of the restoration of fairness. The freeing of workers and the saving of the wage as a result of the use of new equipment in many instances mean that the intersectorial redistribution of labor, for example, from motor transport to the automotive and other sectors of industry, which are involved in the production of vehicles of a greater load-carrying capacity, has occurred. The decrease of the expenditures of living labor in case of an increase of the material expenditures, particularly the amortization deductions (if the price of a motor vehicle per ton of load-carrying capacity increases), is a

manifestation of such redistribution (absolute and relative). The method of the comparison of the saving of living labor with the additional material expenditures, which is characteristic of this mechanism of the funds for the remuneration of labor, is of great importance for the accomplishment of "economic fairness."

In the mechanism, which has been checked, such a comparison takes place within the framework of the comparison of the saving of the wage with the above-plan profit. But if the additional material expenditures are covered by the additional profit, which was derived by means of above-plan transportation and other services, such expenditures do not influence the amount of the saving of the wage, which is transferred to the material incentive fund. Since this mechanism of the funds for the remuneration of labor does not ensure the constant consideration of the interchange of living and embodied labor, the external interference in the use of the saving on the wage fund has objective bases. The need for the consideration of this exchange at the stage of the distribution of the formed saving will disappear, if it affects the measure of labor.

In the departments of the railroads the requirement of the absolute reduction of the number of working people serves as a substantial restriction on the use of the saved wage. In case of an increase of the volumes of transportation it is possible only at the initial stage of the work according to the Shchekino method. The rejection of this requirement will make it possible to extend the Shchekino system to not only the absolute, but also the relative saving of the wage.

The use of the Shchekino system under the conditions of the relative decrease of the number of workers is a difficult problem. With respect to several occupations not all the departments of the railroads are manned with personnel. The failure to observe for this reason a number of norms of service affects the quality and economic results of the work of not so much this as other departments, even outside the railroad. The adjusted freight turnover as a measure of labor, which regulates the wage fund of the departments of the railroads, does not reflect the quality of the performed work. Therefore in case of a standard of the wage, which corresponds to the necessary number of workers, a stimulus for the preservation of undermanning and a low quality of work will arise. If the standard of the wage per 1,000 ton-kilometers takes into account the level of the expenditures of labor, which formed in case of undermanning, its elimination will cause an overspending of the wage fund. The general solution of the problem, apparently, must be sought in the direction of the development of intratransportation cost accounting relations with the use of penalties, which should affect the measure of labor. It is natural that the use of the freight turnover in the function of this measure is ruled out in such situations.

The revenues and profit at the inspected enterprises of motor transport act as measures of labor only for the adjustment of the planned funds of its remuneration. The introduction of new measures of labor almost did not affect the stage of planning. Moreover, the freight turnover, although it ceased to be an evaluation indicator in the cost accounting sense, remained such from an administrative point of view and forms a part of the obligations of the socialist competition. Therefore the effectiveness of revenues as a measure of labor in motor transport was reduced.

In the departments of the railroads the mechanism of the wage fund turned out not to be coupled with cost accounting which is based on the system of revenues. The rates of return also include the wage as one of their components. It would seem that the right to the wage fund should be determined by the revenues and the share of the wage, which is incorporated in them. In any case, in case of reflection in the profit the saving or overspending on the wage is established by the comparison of the actual wage fund with the corresponding components of the actual revenues. But since the adjusted freight turnover is used as a measure of labor, the saving (overspending) as against the standard wage fund, as a rule, will not coincide with the corresponding components of the profit. What is the actual result of the activity?

In the process of the experiment it was never possible to ensure the stability of the standards of the remuneration of labor. At the enterprises and associations of motor transport they were changed when approving the annual plans. In the departments of the railroads the standards of the five-year plan were not in force, while they were altogether absent in the annual plans.

The deviation of the actual conditions of activity from the planned conditions is the general cause of their instability. There is, first of all, the adjustments of transportation tariffs, the prices for means of production and the remuneration of labor, which are not reflected in the five-year plan. Due to the unprofitability of the operation of trucks with remuneration by the hour and of urban buses and the significant differences in the ratios of the wage and revenues and in the norms of the surplus product, which are connected with this, the unplanned change of the structure of transportation services has a definite destabilizing influence on the standards of the remuneration of labor.

But the strongest factor of instability stems from the complex and contradictory connection of the average wage with labor productivity. The increase of the average wage is predetermined not so much by the increase of the output at the enterprise or in the sector (local labor productivity) as by the increase of the productivity of national labor. Due to the sectorial differences in the rates of scientific and technical progress and as a consequence of the influence of natural conditions the planned increase of labor productivity in a specific sector, and especially at a separate enterprise, as a rule, is greater or less than the rate of increase of the productivity of national labor. In the standards the average wage is connected with the local labor productivity.

This objective contradiction makes the standard of the wage dependent on the conformity of the achieved local labor productivity to its planned level. Under the conditions of the intensifying division of labor external circumstances (for example, timely deliveries of oversize trucks) are influencing more and more the increase of labor productivity. And when it is not possible to ensure these conditions, which do not depend on the enterprise, in order not to allow the drain of personnel, they agree to an increase of the standards of the wage by means of their decrease in other sectors and enterprises, in which the saving of the wage is formed. Thus, in the Belorussian SSR Ministry of Motor Transport in 1980 the standard of the wage, which was approved by the annual plan, exceeded the analogous indicator of the five-year plan by 8.13 percent, while in the Main Administration of Motor Transport of the Moscow Oblast Soviet Executive Committee it was 1.37 percent less. The interconnection of national

and local labor productivity is complicated by the fact that in transportation at present not the national income (the net product), but the adjusted freight turnover or the revenues serve as the basis of the measurement of labor productivity.

The need for the leading increase of local labor productivity has a substantial influence on the connection of the standards of the wage with local labor productivity. The standardization of the ratio of the growth rates of the average wage and local labor productivity is playing an important role in the determination of the levels of the standards of the wage. The analysis showed that unsound ratios were used when drafting the five-year plans for 1976-1980, therefore when drawing up the annual plans they were, as a rule, substantially revised.

But one properly established ratio of the growth rates of the average wage and labor productivity is insufficient for the assurance of the stability of the standards. Since this ratio, as a rule, is not equal to one, at the specific transportation enterprise a special standard of the wage should correspond to each level of labor productivity. Therefore, it proves to be too low, if it is not possible to achieve the local labor productivity envisaged by the five-year plan, or too high, if the plan assignment is exceeded. The more greatly the accepted ratio differs from one, the more the inadequacy or excessiveness of the standard will be felt in case of the same deviation of the actual labor productivity from the planned labor productivity. On the basis of the estimates of experienced workers it is possible to draw the conclusion that the deviation of the real need in the wage from the standard by more than 1 percent requires a change of the standard. Theoretical calculations show that given a ratio of the growth rates, which is equal to 0.4, it is necessary to change the standard, if the deviation from the planned labor productivity exceeds 1.7 percent. It is obvious that it is impracticable to plan the local labor productivity for several years ahead with such a degree of reliability so as not to allow such deviations.

From the analysis of the results of the experiment it is possible to draw the following conclusions:

first, in case of the use of the adjusted freight turnover or the revenues as measures of labor it is impossible to realize the principles of the Shchekino system, since these indicators do not reflect the interchange of living and embodied labor;

second, the unequal sensitivity of the remuneration of labor to the change of different types of expenditures and the same types of them, but in different situations, suggests that the coordination of cost accounting and national interests is not being ensured;

third, the instability of the standards of the remuneration of labor has certain objective bases in the nature of the connection of the average remuneration of labor and its productivity.

The Means of Improving the Economic Mechanism of Transportation

An experiment under production conditions makes it possible to test the new economic mechanism mainly for "viability." An experiment under more "pure" conditions--on mathematical economic simulation models--is necessary for the comparison of the versions of the organization of the economic mechanism and the ascertainment of their influence on its individual characteristics. Such an experiment on models of the mechanism of the funds for the remuneration of labor made it possible to draw the conclusion that the coordination of the cost accounting interest (the maximum average remuneration of labor) with the national economic interest (the maximum productivity of national labor or the minimum differential expenditures) is possible only if in the process of the interchange of living and embodied labor the former is evaluated by some norm of the produced net product (newly created value). The analysis showed that such a condition is not always compatible with a sufficiently great sensitivity of remuneration to the expenditures of aggregate labor. Thus, the mechanism of the funds for remuneration, which was introduced in 1965 and in case of which the maximization of the average remuneration of labor (in case of the given volume and structure of the production of output) was carried out by means of the distribution of the profit, in principle (that is, in case of its possible improvement) ensured the evaluation of labor by the norm of the net product being produced. But the weak sensitivity of the remuneration of labor to the change of expenditures was its most significant drawback. For this reason it was replaced in 1979 by a mechanism, which in principle coincides with the one which underwent experimental checking in transportation. In case of this mechanism a unit of living labor in comparison with a unit of embodied labor is evaluated by the average remuneration.

The solution of the identified problems of the formation of the funds for the remuneration of labor is possible in case of transformations, the essence of which consists, first, in the transition to a common measure of labor of the collective--the actually produced net product and, second, in the introduction of self-adjusting standards of remuneration. Let us examine these transformations in light of the analyzed economic experiments.

The transition to a common measure of labor will serve as the basis for the unification of the wage fund and the incentive funds into a common fund for the remuneration of labor, which is defined as a planned proportion in the produced net product as an integral object of cost accounting appropriation (much like the present incentive funds). The fulfillment of production operations and functions will first of all be paid for by means of the common fund (which now constitutes the content of the wage fund). The remainder of the common fund wull be distributed between the incentive funds and the reserve. Of course, the saving or overspending on the wage will affect mainly the amount of the incentive funds. As we see, the trends of development of the mechanism of the funds for the remuneration of labor, which have already been identified during the economic experiment: the determination of the planned wage fund and material incentive fund on a common basis and the interflow of the funds, receive their natural and logical conclusion.

Under these conditions the profit is freed of the functions of a measure of labor (having transferred them to the net product), but retains the role of a

source of accumulation. Among the transferred functions of a measure of labor there will also be the comparison of the opposite changes of its various types, which reflects their interchange. The replacement of living labor by embodied labor will cause an increase of the material expenditures and an equal decrease of the net product, so that the comparison of the saving of living labor with the additional material expenditures will constantly and automatically take place at the stage of the determination of the measure of labor. It is then already possible to establish the fund for remuneration with allowance made for such a comparison. Therefore the need for the subsequent comparison of the saving of the wage with the above-plan profit disappears. The State Bank will be able upon the presentation to it of the balance sheet data on the actual amount of the net profit to assign the proportion, which is due to the collective of the enterprise, to a special account; any withdrawal of assets from it is possible only in accordance with a decision of the court or the State Board of Arbitration. The influence of outside factors should be eliminated by the regulation of the prices for means of production, which are used by transportation, and transportation tariffs, as well as by means of the turnover tax or fixed payments.

By way of amplification let us note that it is necessary to define the common fund for the remuneration of labor as a proportion of the accounting net product, that is, after the exclusion of the fee for productive capital, the interest on credit and the balance on fines. The latter circumstance creates objective prerequisites for the reflection in the measure of labor of the quality of the performed work. If it is low, the accounting net product will be reduced by the amount of the additional material expenditures and the fee for capital, which are due, say, to the slowing of traffic on the railroads due to the poor condition of the track. Moreover, the accounting net product will be reduced by the amount of the fines for the untimely delivery of freight and the turning over of empty cars for loading, as well as for the violation of the intratransportation standards of the quality of work (for example, for the untimely turning over and acceptance of rolling stock from railroad to railroad, the violation of the plan of the making up of trains and so forth). As a result undermanning, to the extent to which it causes a decrease of the quality of work, will not provide a saving on the fund for the remuneration of labor. And on the contrary, the bringing of the staff up to full strength and the increase of the quality of work will automatically ensure the necessary increase of this fund. It goes without saying that in this case it is a matter only of the fundamental ability of the measure of labor in the form of the accounting net product to reflect the economic consequences of the quality of work and services. The realization of this ability presumes further research, the settlement of procedural questions and much organizational work.

A fundamentally important circumstance is the fact that in case of the formation of the common wage fund in a proportion of the net product a unit of living labor naturally receives monetary evaluation according to the norm of the net product, which is formed at the enterprise. The comparison of the saving of living labor with the possible additional material expenditures takes place on this basis. The prerequisites of the coordination of cost accounting and national interests, which are realizable in case of the optimum tariffs, are thereby created. There serves as a distinctive trait of the latter the fact that in them a unit of the living labor, which has been spent in the optimum

technical and operational version of the development of the enterprise of transportation, receives monetary evaluation according to the social norm of the net product. At the same time a great sensitivity of the remuneration of labor to the change of its expenditures is ensured. Calculations showed that in the system of the Belorussian SSR Minister of Motor Transport under the conditions of 1976, which preceded the increase of the prices for liquid fuel, if the economic mechanism, which was introduced in 1965, had been in effect, the coefficient of sensitivity would have been equal to approximately 21 percent (the proportion of the incentive funds in the accounting profit). In other words, in case of the saving (overspending) of the material expenditures by 100 rubles the incentive funds would have changed by 21 rubles. At the same time the proportion of all the funds for the remuneration of labor in the accounting net product came, according to the calculations, to 72.5 percent. The coefficient of sensitivity would have been such, if the common fund for the remuneration of labor had been formed as a proportion of the accounting net product. Indeed, in case of a saving (overspending) of material expenditures in the amount of 100 rubles the common fund for the remuneration of labor would have changed by 72.5 rubles. As we see, given the same amounts of the common fund for the remuneration of labor a more than threefold increase of its sensitivity to the change of the expenditures of labor is possible.

The transition to the accounting net product as the common measure of labor also creates the prerequisites for the increase of the stability of the standards of remuneration. It was noted earlier that the conformity of the content of the productivity of national labor and local productivity influences stability. The latter is defined as a measure of labor which regulates the wage fund. The labor productivity of the collective of an enterprise, which is determined in terms of the accounting net product, is the local productivity of national labor. Moreover, their stability is greater, the less the standards depend on the structure of transportation services. In turn such independence is more complete, the greater the possibility is to equalize the remuneration and the measure of labor by types of services. The more thoroughly the tariffs reflect the socially necessary expenditures of labor on the services of transportation, the greater the extent to which the equalization of the indicated ratio by types of services (including transportation) occurs.

The increase of the dependence of the labor productivity of the collective on the observance of the planned production economic conditions (first of all on the making available for transportation of the corresponding volumes and the composition of freight, on material and technical supply) requires the "protection" of the measure of labor of the collective from violations of the obligations facing it. Of course, it is necessary to enhance the role of long-term contracts with clientele (or the organs which determine the deliveries) and with the suppliers of means of production for transportation. But only in case of the use of the accounting net product as the measure of labor is the compensation for this measure at the expense of the guilty party possible.

And still the objective prerequisites of deviations of the actual operating conditions of transportation from those planned for the 5-year period remain. These deviations can be in both unfavorable and favorable directions, therefore it is possible to accomplish the task of the combination of the stability of the standards of remuneration and the assurance of the necessary ratio of the growth rates of the average remuneration of labor and its productivity only in

case of self-adjusting standards. Self-adjustment presumes the firm establishment of the indicated ratio as an economic standard of the five-year plan. The standards of remuneration themselves should be specified in the five-year plans by estimation as the basis of the planning of the fund for the remuneration of labor. By proceeding from them and basing oneself on the standard ratio of the growth rates and the percentage of fulfillment of the assignment on labor productivity, which was used in the five-year plan, it is possible to establish the standards of remuneration for the State Bank (this does not formally preclude other, but equivalent methods of the self-adjustment of the indicated standards).

Calculations showed that even if the actual ratio of the growth rates of the average wage and labor productivity had been incorporated in the five-year plan of the Belorussian SSR Ministry of Motor Transport, due to the failure to ensure the planned increase of labor productivity the standard of the wage for 1980 would have to have been increased in the annual plan by at least 2 percent. The consideration of the fulfillment of the plan on labor productivity by 92.7 percent in case of a ratio of the growth rates of the average wage and labor productivity of 0.73 gives grounds to increase the standard of the wage by 2.1 percent. This, of course, is the ideal coincidence of the actual wage fund with the results of the theoretical calculation. At the same time the analysis of the data with respect to the Main Administration of Motor Transport of the Moscow Oblast Soviet Executive Committee showed that the special consideration of the underfulfillment of the assignments on labor productivity by 3.7 percent was not required for the assurance of the necessary level of the standard of the wage; it was sufficient to take the actual ratio of the increase of the average wage and labor productivity or the one which was established in the annual plan. Therefore it is a matter not of final conclusions which make it possible without any doubt to change over to a new type of economic mechanism, but of the questions, which arose during the experiments and need careful study and checking, first of all on the basis of a comparison with the practice of implementing the decree on the economic mechanism of transportation [2].

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CSO: 8144/1422

MATHEMATICAL METHODS IN TRANSPORTATION DECISION MAKING

Moscow EKONOMIKA I MATEMATICHESKIYE METODY in Russian Vol 20, No 2, Mar-Apr 84 (manuscript received 14 Apr 83) pp 223-231

[Article by Doctor of Economic Sciences Boris L'vovich Geronimus, senior scientific associate of the Scientific Research Institute of Motor Transport of the RSFSR Ministry of Motor Transport, Candidate of Technical Sciences Vladimir Aleksandrovich Zhitkov, chief of a laboratory of the Central Institute of Economics and Mathematics, and Candidate of Technical Sciences Viktor Al'bertovich Roze, chief of a sector of the Institute of Complex Transportation Problems attached to the USSR State Planning Committee (Moscow): "Mathematical Models in Decision Making in Transportation: The Evolution of the Methodology"]

[Text] The use of mathematical methods in the present understanding and on a modern technical base for planning and management in transportation began more than 20 years ago [1, 2]. Now it is possible to say that in this time mathematical methods and computers have not yet been become a sufficiently effective tool of the planning and management of the activity of transportation organizations.

From the point of view of the general methodology of the use of mathematical methods in the national economy precisely transportation, in our opinion, is most interesting: first, mathematical methods began to be used here earlier than in many other sectors of the national economy and, second, transportation as a whole as an object of economic management, perhaps, is most diverse in its characteristics.

From the start of the use of mathematical methods in the management of transportation the optimum solution of planning problems, and very often of an operational level, at which these problems seemed most specific and the work with them most often took place under the exacting conditions of "time trouble," was considered their basic role.

Indeed, the planning problems, which were aimed, as a rule, at the obtaining of some better results, at first glance quite easily allowed correct mathematical statements and then could be solved most effectively (in the sense of the degree of achievement of the set goal) precisely by mathematical means with the aid of computers. In this respect the traditional "manual" solution of the same problem was obviously inferior to the computer solution. Moreover, mathematical methods usually yielded the guaranteed optimum solutions (or with a

deviation from the optimum within a guaranteed range), which it was no longer possible to surpass. The basic impact of the use of mathematical methods was seen in these guarantees, but it was expected in addition to it that mathematical methods would free the skilled workers of the management staff from labor-consuming work and would expedite as a whole the process of obtaining planning decisions. In general mathematical methods and computers were considered the most important means of the improvement of planning in transportation, but at that time their role specifically consisted in the fact that they "will make it possible to raise economic planning to a high level and to change over from satisfactory, for the most part balanced plans and decisions to the best, optimum ones" [3, p 4]. That "objective" formal methods would successfully replace traditional "subjective" methods in many spheres of management and, what is the main thing, the human specialist in the settlement of questions of planning, did not arouse doubt. Such a direction of the use of mathematical methods instead of man in the system of management was very characteristic of the 1960's and in many ways is also being preserved today.

The usual "technology" of the introduction of mathematical methods in this case appears as follows. In a really operating system of planning one or several units of the nontrivial processing of information are distinguished for several preliminary reasons. It is assumed that the activity of man (or an organizational subvision) in the solution of the chosen problem is insufficiently effective first of all due to his inability to settle complex planning questions at the required rate and with a high quality. Then this activity is studied (investigated) primarily according to the input-output, and on this basis the mathematical problem is formulated: the sought variables are chosen, the range of their permissible values is distinguished, the optimality criterion, which in many ways is formulated under the influence of standard considerations, is set. After this the method of solving the posed problem is sought or developed, its program realization and the technology of the functioning of the automated section of planning work in the overall mechanism of planning are elaborated.

It is necessary to stress the procedurally important features of this process: officially some outside (for the ones being investigated) collective studies (investigates) the problems, which are actually being worked on by the planning subdivision during a certain period (for example, the time of the investigation); formalization is regarded as a necessary stage of the use of mathematical methods and computers and reduces to the use of a scheme of mathematical programming; the range of permissible values of the chosen variables is distinguished "rigidly," for general reasons (which have frequently been "raised" to the level of statewide interests) the optimality criterion, as a rule, one, is set (but not so much perceived in reality). Introduction consists in the persistent attempt to replace the human decision by an "objective" computer decision.

The mathematical differences of the criterion functions or (and) conditions, which determine the range of the permissible values of the variables, gave rise to formally dissimilar problems of transportation planning. The difficulties of a mathematical and computing nature, which arouse here, at first attracted much attention of specialists, and each positive result in this direction in many ways was regarded as a success in the sphere of the economic management proper of transportation. With time such work took a prominent place in the

scientific and educational literature on the management of transportation (see, for example, [4, 5]), while procedurally was the basis of the broad administrative movement for the development of automated control systems in various types of transportation [6, 7]. Moreover, this direction as a whole, on the one hand, led to the considerable development of the applied and computer sections of mathematics and, on the other, stepped up the process of the more thorough interpretation of the problems of transportation planning.

With the accumulation of experience in the work with mathematical methods it appeared more and more often that even the carefully determined estimated impact from the automated (or optimum) solution of some problems or others of planning in reality was unattainable. Undoubtedly, there were examples of the successful and efficient use of mathematical methods for the solution of the problems of transportation planning, primarily of a projective and a technical and economic nature: work on the stage nature of the development of railroads (let us say [8]), on the optimization of the structure of the fleet of transport ships [9]. Moreover, cases of the successful use of the body of optimization mathematics in the solution of the problems of operational planning in the railroad (for example, [10]) and for truck transport (see [11]) are known. Still as a whole, in spite of the effectiveness of mathematical methods, they were introduced in practice with great difficulty and most often as a result of administrative pressure. As a result, for example, in the Main Administration of Motor Transport of the Moscow City Soviet Committee--one of the leading organizations of the sector in the persistence and standards of the use of mathematical methods--nearly 20 years after the organization of a special computer center only about 8 percent of the total volume of transportation is encompassed by planning on the basis of mathematical methods, moreover, of the optimal routes, which were calculated on computer, as a whole scarcely 50 percent is being carried out [11], and in recent times this indicator has not improved. Similar results are also noted in other motor transport organizations [12]. It is far from always possible to explain such a situation by the unreliability of the information, subjective causes, inadequate production standards, executive discipline and so forth.

The difficulties in the use of mathematical methods to a significant extent were due to their economic rejection, which stemmed from the actual disinterest of transportation organizations in these methods under the conditions of the prevailing economic mechanism. But it was a matter not only of the fact, for example, that the chosen goal directivity of mathematical methods frequently did not comform to the actual (but not declared) aspirations of these organizations. A significant reason lies in the methodology of the work with mathematical methods and consists in the too "optimizational" use, which was oversimplied from a cybernetic point of view, of the problems of planning. We also discuss in what follows precisely this aspect of the problem of the introduction of mathematical methods.

The first attempts to analyze the failures (the late 1960's and early 1970's) led first of all to the idea of the inadequate detail of the reflection of real circumstances in the models. As a reaction to this circumstance the descriptive trends in modeling intensified: the number of conditions and restrictions increased, the criterion became complicated. The complexity of the models increased, and as a result the mathematical and computing difficulties of the

calculations increased even more rapidly. This contradiction in a number of cases was overcome by the entensive use of algorithms of the search for approximate solutions. Such an approach became most prevalent in case of the solution of planning problems at all levels of the management of transportation, up to the level "USSR State Planning Committee--transportation ministry" [13].

The further development of the descriptive trend in the formulation of the problems of planning in transportation led, in particular, to the appearance of so-called mild restrictions, which form the "blurred" range of permissible values of the variables: the choice of variables farther (in a certain sense) from the center of the range entails an increasing "penalty" as a negative addition to the functional. Formally this was only the complication of the criterion function, on the practical level such methods made the models much more acceptable for practice.

At approximately the same time out of the natural desire to increase the speed of the solution of the problems of planning and to improve in reliability, timeliness and degree of economy the information support of the process of drawing up the plan the efforts of the developers of automated control systems to a great extent were aimed at the development of packages of programs and integrated software [14], which integrates the database for several problems of planning and yields at the output the most ready-to-use (in the sense of document makeup) planning decisions.

The next and very important step (the second half of the 1970's) in bringing the formal structure closer to the real process of planning consisted in the recognition of the essential multicriterion nature of the problems of planning and, in essence, the indistinct dividing line between the restrictions (conditions) of the problem and the criterion goals. The understandable desire to preserve the mathematical certainty of the problems and the standardized nature in the goals and the conditions of their solution gave rise first of all to various methods of reducing the multicriterion problems to traditional single-criterion problems: "convolution," the tactic of the sequential use of criteria and so forth. In spite of the fact that from a formal point of view it was possible to regard these methods as an attempt to escape the real difficulty, they facilitated in many ways the interaction of man with computers. At first such interaction was quite timid: the specialist, who is competent in the performance of the corresponding planning function, prior to the decision could set up a program package and after obtaining an unsatisfactory result could repeat the calculations, if time remained for this. In the program package described in [15] it was possible, for example, after the analysis of the initial conditions (in part with the aid of a computer) to specify: the tactic of optimization (sequential or parallel), the weighting convolution of several criterion functions (from a fixed set), the degree of inflexibility of the restrictions, the desired completeness, the accuracy of the decision and so forth. The obtaining of operational evaluations of the restrictions (a certain analogue of the partial derivatives of the criterion function with respect to the restrictions) and the statistical processing of the made decisions for the obtaining of data for the self-adjustment of the program package, but without the interference of man directly in the course of the decision was envisaged for the more intelligent management of the computing process. In many ways this stemmed from the limited technical and general program possibilities of

the computers of that generation, the technology of the use of mathematical methods in transportation, which had been in effect, as well as the identified quite great demands on the competence of the expert (user) both in the area of planning and in the knowledge of the details of mathematical methods.

Perhaps, in such cases the participation of man in the elaboration of a decision with the use of formal means was based on arguments which ran in the opposite direction: from the general idea about the need for the use of an expert with its advantages, which show up during the elaboration of the decision, to the making of equipment available for the more complete utilization of these advantages.

The traced evolution signified, in essence, the revision of the status of "objectivity" in the solution of the problems of planning, which was previously ascribed to mathematical methods. In general the realization of the imaginary nature of this objectivity and of the fact of "the transfer of arbitrariness from one instance to another" [16, p 106] in case of the use of mathematical methods in the systems of management with the participation of man attracted the attention of specialists to his activity on the statement of the goals and problems.

To begin with, it turned out to be very important that the planning problems actually being worked on in the systems of management now in effect, as a rule, are not realized and especially are not formulated by specialists at the level of logical completeness, which is required for the strict mathematical formulation of the problems. On this level such problems (weakly structurized, unstructurized, qualitatively expressed [17]) do not exist "objectively," outside the activity of man, who, depending on the circumstances, to the extent of his abilities and competence efficiently changes the direction of his efforts, or, in the terminology of formal management, solves management problems which are different in the composition of the conditions (by distinguishing the bottlencks), in the goal and so forth. The main thing is the fact that the success of such activity in the process of planning is determined not only, and often not so much by how the posed problem is solved (optimally--nonoptimally, quickly--slowly and so forth), but by what this problem is.

Moreover, the diverse and nonsimultaneous dynamics of the conditions of the solution of the problems of planning (or, as the developers of automated control systems frequently call it [14], "the organizational dynamics"), for the consideration of which in general it is obviously insufficient to change the parameters of the criterion functions and the "right-hand members" of the restrictions, proved to be fundamentally important for planning. As a whole it is a component of the continuous evolution of the informal organizational structure of the systems of management (the replacement of plan indicators, the redistribution of powers and so forth), and precisely this evolution with time "tears away" the automated blocks in the system of planning, which are incapable of rearrangement. Only comparatively rare cases of the weak organizational dynamics of real planning processes are accompanied by practical success (if the other mentioned factors do not interfere).

Thus, the method of introducing mathematical methods, which is customary to this day, by deriving at some moment (during the investigation) from the real

process one statement of the problem or another and drawing it up subsequently in exacting formal rules, commits a kind of "coercion" against reality and then offers means of a "successful" (quick, optimum) solution, but frequently no longer of the problems which practice needs. In other words, the use of mathematical methods had the result that, while having eliminated the subjectivity (inefficiency) of man in case of the elaboration of planning decisions, these methods preserved it at the stage of the statement of the problems of planning, having lost in addition the ability inherent in man to change flexibly the conditions and aims. The negative impact of this circumstance is increased by the essential organizational feature that in many instances of the practical work with mathematical methods the direct solution of one problem or another of planning was taken beyond the organ responsible for the problem (the "client" for the use of mathematical methods), as a rule, up through the levels of management (to the main and multiple-user computer centers and so forth), its statement was recorded in a document and the nature of objectivity was merely lent to it administratively. Here, without having the opportunity to influence efficiently the process of the elaboration of a decision (for the noted methodological and organizational reasons), the client in fact (and quite validly) is forced to ignore the computer decisions, thereby formally violating the administratively assigned procedure of planning. The solution to such a contradiction is seen in the strengthening of the adaptive properties of mathematical methods, and first of all once again through the human "framing" of the automated blocks of planning. In this respect one should note another important aspect in the methodology of the use of mathematical methods in planning.

At the early stages of the introduction of mathematical methods the interaction of man and machine always remained outside the field of view of the developers of the mathematical methods and the nature of the indicated interaction was defined as a secondary result of the development of the automatic blocks of planning. In essence, it was limited to the the coding-decoding of data and the visual monitoring of the results of the solution on a computer. In the last function the role of man reduced to the criticism of the computer solution and if necessary the replacement of it (or individual fragments of it) by a "manual" version. Thus, the interaction of man and machine in form and content was of either a technical or a conflict nature, and in reality a dilemma rose: either man or machine. In case of the solution of this dilemma in favor of the machine the need to decrease significantly the expenditures of labor of skilled specialists in the process of planning, having replaced it with unskilled technical work by means of a computer, was added to all the noted drawbacks of the formal methods. In any case, the introduction of mathematical methods on this level was not harmonious and gave rise to psychologically understandable (and frequently valid) opposition.

From the realization of the noted methodological drawbacks of the use of mathematical methods in transportation, on the one hand, and from the confidence in their usefulness and great possibilities, on the other, in recent times the idea of the use of dialogue systems of the optimization of planning decisions has become more and more popular [18].

In case of dialogue optimization an active role is given to the specialist, to whom the right of the distribution of powers between man and computer, the formulation of the problem, the choice of the direction of optimization and so

on is granted. For the present it is possible to indicate only the most general principles of the construction of systems of dialogue optimization [18, 19].

To begin with, such systems rely on modern general software and computer equipment with developed terminals and, what is the main thing, means of the visual representation of information and dialogue interaction with the computer (displays, plotting devices).

Further, such systems are equipped without fail with means of the receipt, storage and comparatively simple initial processing of the input operational information, as well as with means of the documentary presentation of the obtained decisions. The main goal of the primary processing of operational information is to present it in a convenient (ordered) form for man, so as to make easier for him the clarification of the formed initial situation, the distinction of the bottlenecks and so forth. Here, for example, the conformity of the available transportation resources to the proposed amount of work is evaluated approximately. In case of an obvious discrepancy the planner can immediately make a decision on the adjustment of the initial conditions (order an additional fleet of vehicles, shift the filling of orders in time, turn down a portion of the orders for transportation and so forth) or can set special conditions of the solution of the problem: allow a specific overloading of vehicles, the exceeding of the regulated operating time, the undershipment of freight (for which it is possible to rank its consignees) and so forth. In any case after this first stage ("preproblems" [20]) the planner outlines the course of the further solution.

In a more developed form the process of clarifying the problem facing the planner can be based on a simulation model of the transportation process in question. Strictly speaking, in case of the statement of the problem one of the basic difficulties lies in the establishment of the logical dependences between the chosen (significant) indicators of the quality of the occurrence of the process being planned (the characteristics of the object of planning, management) and the distinguished (from those accessible to the planner) controlled indicators. The higher the level of understanding of these relations is, the more accurate and simple models it is possible to formulate and then analyze (solve) by the means of mathematical optimization. Moreover, in the work with simulation models there is the opportunity both to specify (or narrow to a significant one) the set of indicators of quality and to evaluate the effectiveness of the chosen levers of management. Approximately such a process of the evaluation of the efficiency of the systems of plan indicators in truck transport is presented in [21], true, outside an automated dialogue.

It should be emphasized that the greater the importance of the planning dialogue specialists with the simulation model of the controlled process, the more complicated the problem of choice, which faces them. This is especially characteristic of the highest levels of the management of transportation, in which the decisions encompass no longer only and not so much the technical and economic aspects, but also the socioeconomic aspects, as well as entail substantial "postplanning" consequences (examples of work on the basis of the dialogue approach in case of annual planning at the level of the USSR State Planning Committee are given in [22]). The generation of accurate forecasts (for

several years), the formation of permissible versions of the decision and the operational processing of a large array of information in case of its frequent adjustment and (or) the change of resource limitations present the basic difficulties here.

The use of dialogue as compared with the traditional technology of solving problems increases sharply (as a rule, by a factor of 10) the frequency of the use of automated problems and the number of calculated versions. Experience shows that the causes of the more intensive use of computers and mathematical methods (when devices for the realization of a dialogue are available) are mainly the following: the increase of the efficiency of calculations (at any moment of the appearance of the need); the simplicity and convenience of the change of the conditions or algorithms of the calculations, which is accomplished at the console directly by the planner; the noticeable decrease of the likelihood of errors by means of the visual monitoring at the display screen by the user of the information, which he himself feeds in.

Thus, the solution of complex planning and design problems of the development of transportation systems [19, 22, 23] is based chiefly on simulation models, moreover, the role of the automation of dialogue in the interaction with such models, apparently, is relatively less, the more unique the problem of choice is and the more important the simulation model itself is.

The difficulties of solving the problems of planning are due to the complexity of the finding of rational versions, and therefore dialogue systems are furnished with an arsenal (package, library) of optimization methods which were selected first of all according to the principle of closeness to the objective problems, for the solution of which the system is intended. But methods, which differ in mathematical content, descriptive detail, efficiency in the sense of accuracy, the speed of solution, the amount of required information and so forth, are included in the package. The "diversity" of the package is a positive, although not the only characteristic of the quality of the dialogue system. In the plan of the formation of the arsenal of dialogue systems the experience of the latest achievements (both positive and negative experience) proves to be very valuable, since it gives appraisals of the quality of very diverse methods, which were obtained frequently in expensive practical use. On the basis of these appraisals it is possible to distinguish the methods which are most efficient with respect to some indicators or others. Precisely such methods along with purposefully elaborated new ones should make up the package of modern dialogue systems. A large number of diverse models and methods for the planning of truck transportation, for example, are described in [19, 24-26], in which the characteristics of their efficiency are also cited (especially in [26]).

Two extreme cases are possible directly in the elaboration of a planning decision by dialogue means: the decision is formed entirely by the planner and the computer is used only for its presentation; the decision is accomplished entirely by the computer (of course, under the conditions specified by the planner) and subsequently is evaluated by man, is accepted or not accepted. These two cases, strictly speaking, correspond to the present manual and computer methods of solving a planning problem, if one does not take into account the stage of the preproblem, which, however, it is also possible to fulfill (at the request of man) manually.

Such versions, when the planning decision is elaborated by man in close interaction with the computer (in the iterative mode), are located between these two extreme versions. The possibilities of the organization of a dialogue at this stage are diverse: the planner after the clarification of the initial situation (preliminary task) can specify the sequence of calculations, the formulation of the problem at each stage on the basis of the most important conditions from his point of view, the goal orientation of optimization, the use of some methods or others from the package at the different stages. Such a choice is made by him not at all mandatorily immediately after the entire process of calculations, while it is elaborated or modified during the decision as information is received about the obtained results and about the changing circumstances of planning. It is possible to imagine even the intermediate checking of the decisions on a simulation model. As a result the natural distribution of duties between man and the computer in the process of the search for a complex solution takes place: the computer carries out the routine processing of information and optimizes the partial solutions, while the expert directs the calculation procedure and helps the computer to overcome the formally indefinite stages of the computations, moreover, extensive opportunities are afforded him in the choice of his role subject to competence and skill. Thus, the dialogue system is a tool, by means of which man can draft his own "author's" plan. The interaction of the expert and the computer in the drawing up of the plan with respect to content is based on the unconditional absence of conflict of such a process and on the supplementing of the creative potentials and intuition of man with the computing power of modern computers, the ingenuity and constructiveness of mathematical methods.

For the sake of fairness it is also worth noting the negative features in the use of dialogue systems.

Special utility programs, which ensure the interaction of man with the system, the correct transition from stage to stage, from method to method and so on, are necessary for the organization of the dialogue mode. Precisely these programs (which are additional from the conventional point of view) determine the success of the dialogue systems as such, and the basic difficulty of the elaboration of such systems now lies precisely here. It is also possible to name other difficulties of their use.

The efficiency of the work of dialogue systems both with simulation models and with packages of optimization programs essentially depends on the skills of the planner using them, moreover, not only in the subject area, but also in modeling, the methods of calculations, including their comparative merits and drawbacks. One of the tasks of the utility programs of dialogue systems is to provide opportunities of work to users of different skill, up to the level when the completely automated procedure of obtaining a solution becomes preferable [18]. Thus, the problem of developing subject-oriented software and software for different levels of dialogue interaction is arising. On this level it is possible to name the problems of the development of a new technology of problem-solving, the obtaining of integral evaluations of extensive initial and intermediate information, means of the visual display of these evaluations and so forth.

The skill of the user in the area of the methods of solving the problems of transportation planning should be increased on the basis of both the means of improving the dialogue systems themselves and the necessary training of specialists in this area at higher and secondary educational institutions. In our opinion, it is hardly necessary to increase the size of the corresponding syllabuses; however, it is necessary to orient students toward the mastering of the special-purpose content and efficiency characteristics of the methods, and not toward how they "operate" technically (the latter should primarily interest the developers of the methods, and not the users).

At the same time it is comparatively easy to construct dialogue systems so as to create favorable conditions for the use of the methods of the mutual instruction of man and computer. For work with such systems the expert needs some technical minimum of knowledge and a low initial skill is permissible. This, of course, will affect at first the quality of the plans, but the system itself will guarantee its level, which is specified by today's methodology of the use of mathematical methods. At the same time the planner is afforded greater opportunities for the broadening of his knowledge in contact with computers up to such a development of its techniques and methods, when they can be admitted to the arsenal of the dialogue system.

Summing up the overall evaluation for dialogue systems in transportation, it is possible to say that as compared with the practice of working with mathematical methods, which is chiefly in effect today, they make it possible:

to obtain effective solutions of complex problems of planning;

to naturally "embody" the automated blocks in a real planning system, which is based primarily on nonformalized procedures, having eliminated the criterion and information incompatibility of such blocks;

to solve problems which do not permit complete mathematical formulation;

to use as much as possible the creative potentials of man in the process of decision making;

to rely in planning on specialists of different skills, ensuring sufficiently high quality planning with the participation in it of workers of low skill (and stimulating the latter for the increase of their skills) or accumulating the experience of highly skilled specialists.

Moreover, dialogue optimization presumes free access to computer facilities directly in the structure of the mechanism of planning by means of remote terminals or the introduction of minicomputers. Technical progress in computer engineering entirely fits both versions. Thus, the unnatural (from the point of view of organizational structure) trend toward the excessive centralization of the planning function only on the basis of the need for the concentration of computing work is being eliminated and in this respect better conditions are being created for the extensive use of computer facilities and mathematical methods in planning practice. But, apparently, the main reason for the better introduction of computers and mathematical methods in case of dialogue technology is the psychological change in the attitude of the planner toward them:

he is becoming an active and key person in the solution of the planning problem, he already feels like the author of the results, especially if he understands well the algorithm of the calculation. This is no longer someone's decision, which was delivered from a computer center and requires analysis in order to reject or accept it, to fulfill it or to force others to fulfill it. This is already "his" decision, for which he is responsible and which he is ready to defend. Such, in some sense an unexpected positive impact of the dialogue is noted in a number of works [20, 22], which have been put to regular practical use.

The positive properties of the systems of dialogue optimization give them an advantage even in the comparatively narrow area of their use, where they can compete with the conventional technology of the use of mathematical methods (in spite of the nearly 1.5-fold increase of the labor intensity of their development [22]). The impact of their extensive introduction in all the levels of management of transportation is obvious; in our opinion, precisely this direction should become the main one in the improvement of the procedure of transportation planning on the basis of mathematical methods and computers.

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CSO: 8144/1422

URBAN TRANSPORT SYSTEMS MODELING

Moscow EKONOMIKA I MATEMATICHESKIYE METODY in Russian Vol 20, No 2, Mar-Apr 84 (manuscript received 18 Oct 83) pp 260-272

[Article by Doctor of Technical Sciences Nikolay Olegovich Braylovskiy, senior scientific associate of the Central Institute of Economics and Mathematics (Moscow): "The Modeling of Urban Transport Systems (Experience, Problems, Prospects)"]

[Text] The Evolution of Transportation in Cities and Transportation Research

The natural development of cities, particularly the increase of the production volumes at enterprises, are leading to the intensification of exchange processes, which ensure the vital activity of the urban organism. The demand for passenger transportation objectively increases more rapidly than the traffic and carrying capacities of the transport systems; as a result ecological, social and economic losses (environmental pollution, an increased level of traffic accidents, the inadequate comfort and great length of trips of residents and others) can arise. Therefore the problem of increasing the efficiency of the transportation service of cities is very urgent.

The management of the transport system is accomplished in autonomous functional subsystems of the control of the designing of roads and urban transport planning, the planning of passenger transportation, the organization and safety of road traffic. In case of a small load of transport systems, which was characteristic of our country until the 1950's, the functional subsystems of control had the opportunity to operate independently. However, with the sharp increase of the transportation load their inadequate suitability for the assurance of the great efficiency of service came to light.

Thus, until recently the urban development plans were oriented chiefly toward the solution of architectural and layout problems without adequate transportation studies. As a result in a number of cities arteries of freight traffic are frequently absent, the density of the transport network is low, disproportions of the development of nonhigh-speed and high-speed types of transportation exist. Instances are known, when regions of new construction for several months were not able to be settled due to the inadequate carrying capacity of passenger transport, and after settlement for a long time yet the residents experienced great difficulties in transportation service.

The formed structure of the management of freight transportation in cities is frequently aimed at the solution of "their own" sectorial and departmental problems. At the same time surface public transport proves to be relatively less advantageous, which at times leads to the shortage and poor technical condition of rolling stock and the low quality of its operation.

The development of scientific research in the area of urban transport followed the evolution of functional control systems. As a result several scientific directions on the modeling of passenger traffic [1-3], freight traffic [4-8], transportation connections [9-16], traffic flows [17-20] and others were formed. Along with the successes in the development of these directions from a system-wide point of view it is possible to note the following shortcomings. Due to the isolation and narrow specialization of studies there is no unified classification of transportation processes according to the attributes of the importance and urgency of the solution of the corresponding problems; there is no methodological unity in the approaches to the solution of even problems of the same type; the models being built often are incompatible with regard to information; terminological disagreement and the duplication of experimental and theoretical developments are occurring.

In the past decade in our country the preparation of more general approaches to the increase of the efficiency of transportation service, which include components of the listed scientific directions and take into account all the basic factors which influence the functioning of the transport system of the city, was started in connection with the aggravation of the transportation problem. The need for a uniform view of the management of the transport system is understood both by specialists in the area of mathematical economic modeling and by the planners of transport systems.*

The practical and theoretical work of recent years testifies that a theory of transport systems of cities, which unites into a unified goal, conceptual and model positions uncoordinated questions of the management of transportation processes in cities, is being formed [1, 9, 20, 21, 22]. The structure of this direction is described below (see work [22]).

The Uniform Simulation Model of the Transport System

There are regarded as components of the transport system of a city: 1) the needs (demand) for the transportation of passengers and freight, 2) the graph of the transportation network, which ensures the movement of passengers and freight by all types of transport, 3) rolling stock of all types, 4) the clients of the transport system (the participants in the traffic). The functioning of the transport system is the process of the realization of the needs for transportation. The state of the system in general is described by the set of characteristics of its components and the resulting indicators of

*As evidence of this it is possible to note the work now being done on the substantiation of the master plan of the comprehensive development of transportation of Moscow for the distant future. For the first time in world practice the transport system of a large city is being studied with allowance made for all the basic factors which influence the efficiency of transportation service.

transportation service, which are connected with them, such as transfers, routes and flows on the curves of the network of passengers and vehicles.

Thus, the functioning of the transport system is examined with, wherever possible, full allowance made for the cause-effect mechanism which forms its condition, on the basis of the objective needs of the city for transportation and the limited conditions of their satisfaction. The advantages of such a description of the transport system consists in posing and solving uniformly all the traditional functional transportation problems within the framework of general information and terminology, uniform algorithms of the calculation of the state of the system.

The development of the methods of the modeling of urban transport systems began almost at the same time as the dissemination of optimization methods in all the sectors of the national economy. However, in contrast to the general trend of those years the "purely" optimization problems in case of the study of the efficiency of urban transport systems in practice were not solved and are not being solved to this day. Owing to the conceptual and computing complexity of the object of study most often it is not possible even to pose correctly the optimization problems. This fact was realized back in the first works on the modeling of urban transport systems, and therefore simulation modeling began to be developed intensively as the basic tool of their study (the city and its transport systems are one of the first objects of the application and development of the ideas of simulation).

More specifically the difficulties in case of the use of optimization approaches and the expedience of the development of simulation methods are explained by the following:

when solving complex problems of the development of transport systems frequently it is not possible to formalize correctly enough the concept of the efficiency of their development and functioning; this especially concerns the socio-ecological aspects of the development of the city and transportation and the socioeconomic characteristics of the behavior of the clients of the system;

the uncertainty of the notions about the future of all its infrastructures, and first of all the layout structure, has a substantial influence on the forecasting of the transport systems of a city, especially for the distant future. Thus, it is well known that the real development of cities almost always does not coincide with their master plans, and often in principle is at variance with them;

the development of transport systems in time is not optimal (from the point of view of the designer), but obeys the general laws of the inertial growth of cities, which it is far from always possible to determine;

a peculiarity of the transport system, which complicates its modeling, is the presence in it of several aspects of purposeful control and behavior. First, as a subsystem of the city organism, it is subordinate to the systemwide goals of development and functioning. Second, in it there are a large number of sectorial and departmental administrations of transportation processes, the goals of which are frequently not coordinated and are contradictory. Third,

the aspiration of the clients of the transport system to achieve "their own" goals leads to the formation of collective behavior, the direction of the activity of which in general does not completely conform to the systemwide goals. The activeness of the object of modeling is its fundamental quality, the disregard of which leads to unfounded decisions in the area of the improvement of transport systems;

the modeling of transport systems, especially of large and the largest cities, comes up against substantial computing difficulties (the large size of the problems and their multicomponent nature).

The complexity of the modeling of the transport system leads to the need for the two-stage solution of the problems on its improvement. At the first the development and functioning of a specific version of the transport system, which is specified with the use of informal or man-machine methods, are modeled (simulated), while at the second the more or less complete optimization of the characteristics of this version is carried out on the basis of formal methods. The stages can alternate in the process of solving the problem, but the obtaining at the first of them of quite realistic evaluations of the state of the system in accordance with the formulated set of indicators remains an unalterable requirement. Here, of course, one has to tolerate the fact that at the second stage the possibilities of optimization are very limited due to the cumbersomeness of the description of transportation processes by the means of simulation.

In case of the simulation of the transport system the question of the composition and structure of the model, which has been adapted for the solution of the most extensive class of practical problems possible by means of standard and general-purpose algorithms, is the most important one. For this purpose all the models are broken down naturally into two groups, which describe the transport system as an object of management (the state of the system) and as its subject (decision making) [22].

In order to describe the state of the system, it is necessary to elaborate models of: 1) the needs for the transportation of passengers and freight, 2) the network, which includes all the types of transport and the types of transportation services, 3) the formation of transportation communications (transfers), 4) the formation of routes and the choice of the type of transport by the participants in the traffic, 5) the characteristics of the traffic and passenger flows on the curves of the network.

The universality of the description consists in the fact that, in spite of the great diversity of the problems of the management of the transport system, they all should contain to the full extent the mentioned models 1)-5) as standard modules. Although the clients of the transport system solve in the system the most different problems, formally their collective behavior is described by the quite universal models 3)-5).

It is efficient to construct the simulation sets of models for the management of transport systems in conformity with the multilevel structure of the time scanning of the management decisions being made. At each level the object of management is described by its own set of essential parameters, which change

in time in the rate of change of the transport and layout structure of the city. It is advisable to examine the management of the transport system at least at the following levels of decision making: long-term planning (25-30 years), intermediate-term planning (10-15 years), short-term planning (5 years), current, operational planning and real-time control. With the increase of the time period of decision making the detail of the description of the state of the transport system increases, but the problems being solved become less complicated.

Thus, the simulation model of the transport system consists of modules of the description of its state, the combination of which with allowance made for the corresponding essential parameters makes it possible to construct simulation sets for all the levels of decision making. The construction of a unified simulation model from quite autonomous sets makes it possible to calculate all the basic characteristics of transportation service, beginning with the long-term, most stable parameters of the system (the layout of the network, the types of transport, transportation accessibility) at the level of long-term planning and ending with the parameters of the organization and regulation of traffic (speeds, delays, load levels, the accident rate and others).

Practically all the known simulation models (for example, [11, 16, 21-27]) of the transport system were constructed logically just as the described unified model, although their real possibilities for the present are limited. Due to the inadequacy of the software and the initial information each of them is aimed at the solution of "its own," comparatively local transportation problem. Nevertheless the aggregate theoretical studies of these model sets nearly cover the entire class of problems of the transport system at all levels of management.

Let us dwell in more detail on the basic questions which arise when developing a unified model of the transport system.

The Efficiency of Transportation Service

The concept of the criterion of the efficiency of the transportation service of the city is being introduced for the objective evaluation of the development and functioning of the transport system. It should reflect such indicators as the time and comfort of the trips of passengers, ecological and traffic safety, the cost factors of the development and functioning of the system and others. The general problems of the formulation of the criterion of efficiency in the case of transportation service and in case of the analysis of other socioeconomic systems have a certain similarity. At times for quite local problems it is possible to single out one leading indicator of efficiency, since objectively several characteristics of the system essentially correlate with each other. For example, the decrease of the load of the street and highway system leads to the increase of traffic speeds, the decrease of exhaust gas pollution and noise and others.

A more general approach, which has become widespread in recent years, evaluates efficiency by the amount of the adjusted expenditures on the development and functioning of the system (with allowance made for the cost reflection of social and ecological factors). Such an evaluation of efficiency is especially

necessary when the transport system acts as a component of a more general mathematical economic model of the development of the city and agglomeration [28]. Unfortunately, the methods of the valuation of several factors today are practically absent (the level of exhaust gas pollution and noise). Moreover, the economic evaluation of the losses of time of the population on travel in the unified criterion of efficiency far from always objectively reflect the "weight" of this indicator in the system. This fact appears clearly when solving the problems of the development of large cities and agglomerations, when their layout structure does not meet the requirements of the transportation self-organization of the city [29] (the time of transportation accessibility should not exceed a specific proportion of the daily budget). As a whole the economic evaluation of the efficiency of the transport system for the present has not yet become a significant argument in the practical planning of cities. The noticed trend of the revival in large cities of ordinary and high-speed street cars with the relative slowing of the development of the subway and surface railless transport, for example, confirms what has been said. The objective difficulties of the development of a unified criterion of the efficiency of transportation service often lead to the need for its vector description and the use of man-machine versions of the formation of transportation plans.

Let us examine the possibilities of the model description of the basic components of the transport system.

The Modeling of the State of the Transport System

The needs for transportation service are taken into account in the simulation model by the determination at the level of the city of the places and volumes of the origin and termination of passenger and freight traffic. The demand for passenger traffic is calculated for several categories of trips of residents for labor, cultural and personal and recreation purposes.

The needs for transportation to work are distinguished when studying the settlement of the residents in cities. Due to the great uncertainty of the long-range forecast of the development of cities it is advisable to study several fundamentally different versions of settlement. The substantiation and detailing of each version should be carried out by informal means by architects, urban planners, economists, sociologists, demographers and ecologists (for the present this is the task of only the urban planner-architect). Settlement as one of the most important subsystems of the city in many ways sets the trends of the development of nearly all its subsystems, and also determines the basic laws of trips of a cultural, personal and recreational nature. This feature is described well by means of simulation, but for the present is understood only at the informal level, which requires the further elaboration of the questions of the structuring of passenger transportation.

The needs for freight traffic objectively are established with significantly greater difficulty, since there are a substantially larger number of varieties of this type of transportation (according to several classifications, more than 100), which are distinguished by the type of freight, the rolling stock, the peculiarities of the organization of the delivery process and others. Moreover, until recently the influence of cargo transport on the functioning and development of the transport system was taken into account extremely inadequately

(both in our country and abroad), and therefore the question of the calculation of the needs for freight traffic remained open. Hence the need for the elaboration of both classifications and methods of the determination of the characteristics of the demand for freight traffic is obvious.

The model of the transportation network is the framework of the entire simulation model of the transport system. This network is described as a multigraph, which contains in general subgraphs for the movement of pedestrians, passengers, freight and vehicles (in different combinations), all the types of service lines and urban transport (surface and underground). Such a multigraph for a large city has a very large size [25] and can reflect the network by a significant number of parameters: the number of traffic lanes, their traffic capacity, the composition and intensity of the traffic flow, the attributes of the organization and regulation of traffic and others [24]. It is natural that at each level of decision making far from all of the listed parameters serve as significant variables of the model. Therefore at present for the solution of specific transportation problems of the city many developers independently of each other are developing models of some fragments or others of the transportation networks, which turn out to be incompatible with respect to information and cannot be united into a single network (although in aggregate they potentially reflect all its elements). Of course, the making of a multilevel simulation model of the transport system requires the elaboration of a unified model of the network together with algorithms of its structuring for the solution of specific transportation problems.

The modeling of the behavior of the clients of the transport system is undoubtedly the most important class of problems of the simulation model. The presence in the system of a large number of people leads to the formation of collective behavior, which forms as a result of the quite independent behavior of individuals who are striving for the achievement of their own goals. The equilibrium state, which is observed in it, is a consequence of systems managements and the adaptation to them of the collective traffic of clients. Any change of such management causes a reaction of the collective behavior and leads to a new stable equilibrium state of the transport system. The need for the consideration of collective behavior when managing the transport system is dictated by the fact that, first, the diversity of the active behavior of its clients is significantly greater than the possibilities of the systems management and, second, the self-organization of the clients is the most flexible means of operational control.

The basic classes of models of behavior reflect the processes of the self-organization of individuals at different levels of the stable functioning of the system, which form the hierarchical structure of collective adaptation with a different time stability. The most important problems of the modeling of behavior are the formation of: the transfers of clients of the system (the most inertial processes of the development of cities, which encompass years and decades, are reflected in this way); the load of the types of transport, the routes of the participants in the traffic and the distribution of the flows over the network (these processes have a different level of statistical stability, which is maintained over quarters and a small number of years); the microcharacteristics of the passenger and traffic flows (on a real-time scale). Let us examine the basic models of collective behavior.

The modeling of transfers is the central problem of all studies which are connected with more or less significant changes in the state of the transport system. This pertains to any type of traffic in the city: labor, cultural and personal and recreational trips of the population, freight traffic, the traffic of common carriers and pedestrians.

The gravitational models of the description of transfers [30], in which the size of the flow between two regions of the network is taken to be proportionate to the product of the volumes of the source and flow of trips and some function of the mutual attraction of regions (the function of the preference of trips, which declines with an increase of the distance or time of the trips of passengers), were first to become widespread. In recent years the principle of the maximum entropy [31]* has begun to be used for the description of collective behavior in transport systems.

The general approach of the maximization of entropy consists in the following. Let there be a set of N points. Assume that the likelihood, with which an individual desires to choose union (i, j) between points i, j, i, j = 1,..., N, is equal to φ_{ij}. The real restrictions on the resources of the city and the transport system, by which the sought matrix of transfers $X = \|x_{ij}\|$ is satisfied, are given

$$\sum_{ij} E_{ij}^{l}(X) = E^{l}, \quad l = 1,\ldots,N, \tag{1}$$

where $E_{ij}^{l}(X)$ is the resource of type l for union (i, j); E^{l} is the known overall limit of the resource of type l. Then the matrix of transfers is determined from the solution of the problem of the maximization of the weighted entropy

$$\sum_{ij} x_{ij} \ln \frac{\varphi_{ij}}{x_{ij}} \to \max \tag{2}$$

in case of the restrictions (1) on the resources of the transport system.

It is possible to see that the solution of problem (1)-(2) gives a system of values of transfers, which satisfies the restrictions (1) and here turns out to be the least "displaced" (in the sense of the magnitude of entropy) from the a priori individual preferences which are expressed by the function φ_{ij}.

The systems significance of the principle of the maximum entropy of modeling consists in the fact that the equilibrium state of a complex active system is regarded at the same time as a "black box," the ways out of which are described by the observable restrictions (1), and from the point of view of individual utilities (the preference function φ_{ij} is everything that the observer knows about the internal connections of the "black box"). The state of the system, which equalizes the effect of systemwide factors and active behavior, is

*The principle of the maximum entropy (likelihood) has been carried over to the theory of complex systems from statistical physics and at present is being used when studying service line networks and information structures and in sciencemetry [32-34].

determined as a result of the solution of problem (1)-(2). The presented methodology has received extensive dissemination for the calculation first of all of transportation to the place of work [10, 12, 35], recreational trips [36] and on various types of transport [3], transfers of passenger cars and trucks [9]. The possibility of the maximum consideration when determining the transfers of the available initial information on the state of the transport system is an exceptionally important aspect of entropic modeling. This makes it possible to structure the model in conformity with the requirements of specific problems according to the attributes of the time stability of processes, the necessary detail and accuracy of the description.

However, for the present not all types of traffic are effectively described by means of mathematical models. First of all this pertains to freight traffic. At best the results of the solution of the linear transportation problem are used for it. Meanwhile the effect of uncontrollable factors of the planning of traffic "displaces" the practicable solutions with respect to the optimum ones, which, apparently, can be described by the methods of the maximization of entropy [37].

The problems of the choice of alternatives by separate individuals in the following statement are of independent interest in case of the modeling of transport systems. There is a set of alternate versions of the achievement by clients of their goals (the set of routes and destinations, types of transport or a combination of types and others); each of the versions to a different degree is satisfactory for them. It is necessary to find a stable distribution of a large number of individuals among the alternate versions.

It is assumed that for each version the individual constructs a utility function. In connection with the fact that the process being modeled takes place against the background of many random influences, the probability of the choice by the individual of each of the alternatives is determined [38]. The identification of the models is carried out according to the results of the processing of questionnaires, which are distributed among various strata of the population. The identification of its preferences with respect to some aspects (alternatives) or others of transportation service is a very frequently encountered problem in cities of developed capitalist countries, on the solution of which the strategy of the construction there of various public transport systems depends. In the USSR the need for the development and use of these methods is also great, which is connected first of all with the prospects of the development of individual transport and new types of public transport; nevertheless, for the present the proper attention is not being devoted to these questions.

After (or at the same time) the transfers and the alternatives of choice for the individual have been determined, the modeling of the routes of passengers and vehicles in the graph of the transportation network is required. Since the client of the system chooses the shortest route (or one close to it), the calculation of the shortest distances between all the peaks of the graph is one of the problems. Without dwelling on this question, let us merely note that the development of high-speed algorithms of the determination of the shortest distances up to now has been very urgent, since the calculations of routes usually take up more than half of the operating time of computers when describing the state of the transport system.

Further the group of routes of individuals, which are close to the shortest ones, are established; the intensity of the use of these routes is determined from the individual preferences of the alternatives of the choice.

The modeling of the distribution of the flows of passengers and vehicles over the network by the superposition of the transfers on the routes is the next class of problems.

Let there be known for the given graph of the network the transfers and the routes of the participants in the traffic between all the pairs of its peaks. Then the determination of the magnitudes (intensities) of the flow on the curves of the graph reduces to the simple superposition of the known transfers on the given routes. If we consider that the participants in the traffic choose the shortest routes in time, the resultant distribution of the flows is the solution of the linear problem on the minimization of the total time of the presence of the client in the transport system.

Thus, in this special case the minimization of the time of travel by each individual leads to the overall minimum time of travel. But such a coincidence of the results of the individual and systems optimization is possible only if the time of travel on the curves of the graph does not depend on the magnitude of the flows in the network. In real networks it increases significantly with the increase of their load, and this requires the corresponding improvement of the models of the distribution of the flows. Therefore it is assumed that the time of travel over the curve is an increasing function of the magnitude of the flow. Individuals, while striving for the minimization of the time of being present in the network, are oriented toward the real values of the flows and construct the shortest routes in accordance with them. The process of choosing routes is carried out by all the participants in the traffic and leads to an equilibrium flow. It has been shown (the Wardrop principle) that an equilibrium state of flows exists and its determination reduces to the solution of the problem of linear programming. The conclusion that in this case the set of individual optimums does not conform with the systemwide goal of the minimization of transportation work, is methdologically important.

In domestic research the Wardrop principle has not become widespread and even is not reflected in the literature. The computational scheme of the realization of the corresponding model is very complex, therefore the development of effective approximation methods is required.

The last class of problems of the description of the state of the transport system is the modeling of the characteristics of the traffic and passenger flows on the curves of the network. The drivers of motor vehicles, while striving for the achievement of their goals (speed, comfort, safety) within the limited traffic capacity of roads and intersections, are forced to maneuver in the overall traffic flow, as a result of which stable characteristics of collective travel (speeds, the likelihoods of change, the waiting time at intersections and others) form. The passenger flows are achieved by all types of surface transport, which moves in the overall traffic flow, and therefore the passenger flows as a component of it are described by stable probability laws (the regularity, speed and comfort of travel, the reserves of carrying capacity, the waiting time at the stop and so forth). With the increase of the load

of transportation networks the problems of the traffic and passenger flows began to be studied intensively, since their resultant characteristics (ecological factors, the load of roads, the likelihood of accidents and traffic jams and others) are the most accessible measurers of the level of complexity of the transportation problem of the city. At present much modeling experience has been gained in this area [17-20]. The traffic flow is formalized in terms of the systems of the queueing theory with a quite intricate mechanism of service and an incoming flow of the complex type. Approximate analytical descriptions of the flows far from always give the required accuracy, and one has to use the methods of statistical tests for the solution of the complex problems of traffic flows.

Models of the Management of the Transport System

Let us examine the most important directions of the modeling of the transport systems of cities at different levels of decision making.

Long-term planning (25-30 years) deals with solutions of the strategic, global problems of the development of transport systems as subsystems of agglomerations. The basic questions are: the determination of the configuration and structure of the transport system as a subsystem of the city, the determination of the types of urban transport and their carrying potentials, the calculation of the characteristics of transportation accessibility and several others.

The most significant connection of the transport system with external systems is observed in case of the substantiation of the trends of development of the city, when the influence of the subsystems of the economy, which determine the basic proportion of the material expenditures and social losses, is examined. Among such subsystems, in addition to the transport subsystem, are the city-forming and city service facilities and the system of engineering service lines. Until recently in case of long-term planning the transportation factor was taken insufficiently into account, which decreases the degree of practicability of the drafted plans of development, especially of the largest cities. Attempts are being made at the model level to show the need for the solution of the problem of the layout of the city with allowance made for the transport system. However, in the majority of works this factor is taken into account only in terms of the valuation of transportation work (in the general goal function) or in the form of the permissible travel time of passengers (in the restrictions) [14]. The experience of solving the problems of the long-term layout of cities and their transport systems [40, 41] led to the substantiation of the following general system of the combined solution of these problems.

In the plan of the city or the nucleus of an agglomeration the most likely outlines of the layout structures, which reflect, for example, the trends of the development of the center and the peripheral regions and of the preferential development of individual directions, the formation of satellite cites and others, are given informally as the initial data. At the first stage in accordance with the models [40], which reflect both the citywide and transportation factors, the local optimization of each preliminary version of the layout structure is carried out, as a result preliminary versions of the transport system are elaborated. At the second stage--in accordance with the found

arrangement of the objects of the transportation gravitation of the city (the sources and flows of trips)--the problem of the synthesis of the transport system [41] with allowance made for the basic demands on its construction is solved.

If at the second stage the inadvisability of any versions of the development of the city (for transportation reasons) is shown, the adjustment of the corresponding outlines of the layout structures is carried out and the stage-by-stage solution is performed again. The advisability of this combined solution was shown in practice when substantiating the development of the nucleus of the Moscow agglomeration for the distant future.

The problem of the second stage is of independent importance and is solved for the substantiation of the development of the types of service lines and the types of urban transport. The long-term models in this case realize the ideas of the simulation of the most likely trends of development of the service lines in case of the need for the fulfillment of the transportation standards (the synthesis of the network) and limited capital investments. For the present such work is at the initial stage. More intensive and systematic research in this area, which takes into account not only the urban development, but also the socioeconomic nature of the problems being solved, freight transport as an equal component of the transport system and the possibilities of man-machine procedures in case of the elaboration of long-term plans, is required.

At the level of the intermediate-term planning of the transport systems of cities (10-15 years) the need for more detailed studies of the efficiency of the functioning of the most important subsystems appears. This level of decision making was studied first of all for the purposes of urban development planning in case of the drawing up of the master plans of the development of cities. The existing computer complexes have been adapted for variant calculations of the most general indicators of the development of the system of passenger transport: transportation service lines (the length by types, the density of the networks, technical and economic characteristics and others), the types of transport (the volumes of transportation by types, technical and economic indicators and others) and the travel of clients of the system (the durations of trips on types of transport, the number of transfers and others) [26, 27, 42]. In recent years the simulation models for the solution of the problems of the improvement of the street and highway networks of cities (the substantiation of the development and renovation of the road networks) [24] have undergone development. However, these directions of modeling for the present are little interconnected, although the urgent need for more comprehensive studies of long-range plans exists. At this level a unified model of the transport system of the city is needed for the coordinated solution of the problems of the improvement of the systems of passenger and cargo transport and the service lines of its high-speed and nonhigh-speed types. Important independent problems are arising in connection with the need for the increase of the accuracy of simulation models and their adaptation to the real conditions of planning. Here the careful preparation of the information base of the calculations [24, 25], the development of more advanced methods of the adjustment of the models [21] and the elaboration of the questions of the dialogue between the computer and man in the process of substantiating the long-range plans are required.

Significantly more accurate and detailed (but also less complex) models of the transport system are necessary for decision making at the level of 5-year, current and operational planning (a 10-day period, month, quarter, 1-5 years). The requirements of the accuracy and detail of modeling are equally high for both the five-year and operational plans, since in this time range the structure and significant parameters of the transport system in principle do not change. At present the questions of current and operational planning are being settled with the use of computer systems in case of the substantiation of the operation of urban passenger transport [43, 44], the study of the problems of the routing of freight traffic [6, 7], the analysis of the questions of the renovation and development of street and highway networks and the organization of traffic on them [24].

The known approaches to modeling at this level have the same contradictions and drawbacks as in case of planning for a longer period. Thus, in the models of the operation of urban passenger transport, which make it possible to calculate the most diverse characteristics of the route systems and the traffic schedules, the indicators of the real traffic flows are not taken into account; it is not possible to do this due to the lack of information for the calculation of traffic. At the same time there are models (for example, [24]), which describe the traffic in detail and make it possible to solve simultaneously the problems of urban development planning and the organization of traffic, but do not "join" with the models of passenger transport. The models, which are intended for the planning of freight traffic, in practice are not connected by creiterion, information or concept with other problems of transportation planning, which reflects the existing status of freight transport in the city. Since the reserves of the street and highway networks are limited and are common to all the subsystems of transportation planning, the development of a unified model of the network and the interconnection of the computer complexes of the system of transportation planning are necessary. This central problem requires the increase of the computing efficiency of the models of transportation processes, the consideration in them of the state of traffic, the elaboration of a system of criteria for various problems and the development of interactive methods of the making of planning decisions.

The next stage of decision making pertains to the level of real-time control in the transport system, which is characteristic mainly of the movement of public transport and traffic. The systems of the operational control of the latter (with the use of a traffic signal light system and others) have become widespread in the developed capitalist countries. Their "boom" abated in the 1970's, when it was realized that the efficiency of these systems increases little with the increase of the technical equipment and complication of the software of the models. There are many theoretical studies on the modeling of traffic and the optimization of the parameters of the telecontrol units for such systems [17]. The simplest means of the regulation of traffic, which have the minimum set of technical devices for the reading of information and simplified software, are operating successfully in a number of cities of our country. The introduction of complex systems of the operational control of traffic in the full amount is objectively being checked by difficulties of a technical order.

The real-time control of the movement of public transport is accomplished by the monitoring of its passage over the route. In recent years this problem has become quite popular. It arose immediately after the decline of interest in systems of traffic regulation. However, studies show [45] that, apparently, it is economically inefficient to develop excessively powerful systems of this type. In any case, it is possible to obtain the same effect of transportation service with substantially fewer expenditures which are invested in the improvement of the system of planning of passenger traffic. Thus, as experience attests, operational control in the transport system should be aimed not so much at the optimization of transportation service as at the monitoring of its state for the purpose of the improvement of the systems of operational and current planning. Therefore, the use of diverse equipment for the reading of information on traffic should be intended not only and, perhaps, not so much for the solution of local problems of operational control as for the development of the information base of the unified model of the transport system of the city.

The Prospects of the Use of the Methods of the Modeling of Urban Transport Systems

So far in the country quite a large amount of theoretical research has been done on the modeling of the transport systems of the city. The performed practical work confirms the exceptional need for methods of modeling, by means of which the development and functioning of transport systems are improved. In particular, in Moscow during the past 7 years the basic problems on the development of transportation service lines and passenger types of transport of the city and the nucleus of the agglomeration have been successfully solved with the extensive use of computer simulation systems [24, 25]. However, for the present these and the other known models are not capable of encompassing the problem of the transport system as a whole; they are oriented toward the study of its individual subsystems (urban development, transportation, the organization of traffic).

The truly efficient use of the methods of modeling as an organizational and technical base should be based on a permanent service of the transport system of the city. The setting up of such a service (a computer center, the means and the organization of the gathering of information, software and others) will make it possible to centralize all transportation information, which is of a systemwide nature and by this will eliminate the existing duplication and contradictoriness of today's methods of gathering data.

As a tool of transportation planning the service should have a unified multilevel simulation system, the model modules of which are grouped properly as applied to the specific problems of decision making at different levels. With development the set of applied programs can solve practically all the transportation problems from a uniform systemwide standpoint.

The question of the interrelations of the transport service of the city and the functional subdivisions of transport urban development, transportation, the organization and regulation of traffic is significant. The transport service does not replace the functional subdivisions, but assumes the solution of the citywide, strategic problems of transportation development, leaving the tactical problems for solution in the indicated subsystems.

It is understandable that the transport service should have powers and specific levers of influence on the functional subsystems, which direct their activity in conformity with citywide requirements under the conditions of a shortage of resources of the transport system. In other words, it is necessary for the goal functions and restrictions of the problems of these subsystems to be monitored and adjusted by the transport service of the city. So that this would become practically feasible, it is necessary to develop mechanisms (including economic) which coordinate the action of the functional subsystems with the systemwide goal. The banning of the driving and a differential fee for the driving of motor vehicles over the main arteries of the city, a parking fee for individual transport and others could be measures of this sort.

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